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THE CONSERVATION OF OUR OYSTER SUPPLY.

By ROBERT F. WALSH.

"OYSTER culture, properly so called, the production of spat by aid of artificial methods, has never been resorted to in this country." And "as the scarcity of seed is one of the greatest difficulties now encountered by the oyster planter, this subject offers an interesting field for investigation."

These statements occur in the Report of the United States Commissioner of Fish and Fisheries for the year ending June 30, 1889; and as the propagation of spat by artificial means has not been resorted to since that time, it will be interesting to examine the general conditions of our oyster supply, and, from ascertained results in foreign waters, consider whether or not such methods would tend toward restocking our depleted oyster beds, or economically increasing the oyster supply.

In the consideration of this subject it will be well, first, to give a brief, general account of the conditions of the existing, working, and outworked oyster beds; and, having ascertained these conditions, as nearly as possible, and made some necessary comparisons, we can more easily consider the advisability of raising spat by artificial methods. The natural oyster of America can not continue to be produced in such abundance as we have been accustomed to find it. The beds of South Carolina have practically given out; the famous oyster beds of Maryland and Virginia —in the Chesapeake Bay region, which Captain Collins calls "the most important oyster region of the world"—are being so depleted of oysters that the "gravest apprehension" is caused as to their future; and only in Connecticut has there been a marked increase, both in the acreage of oyster beds and oyster production,

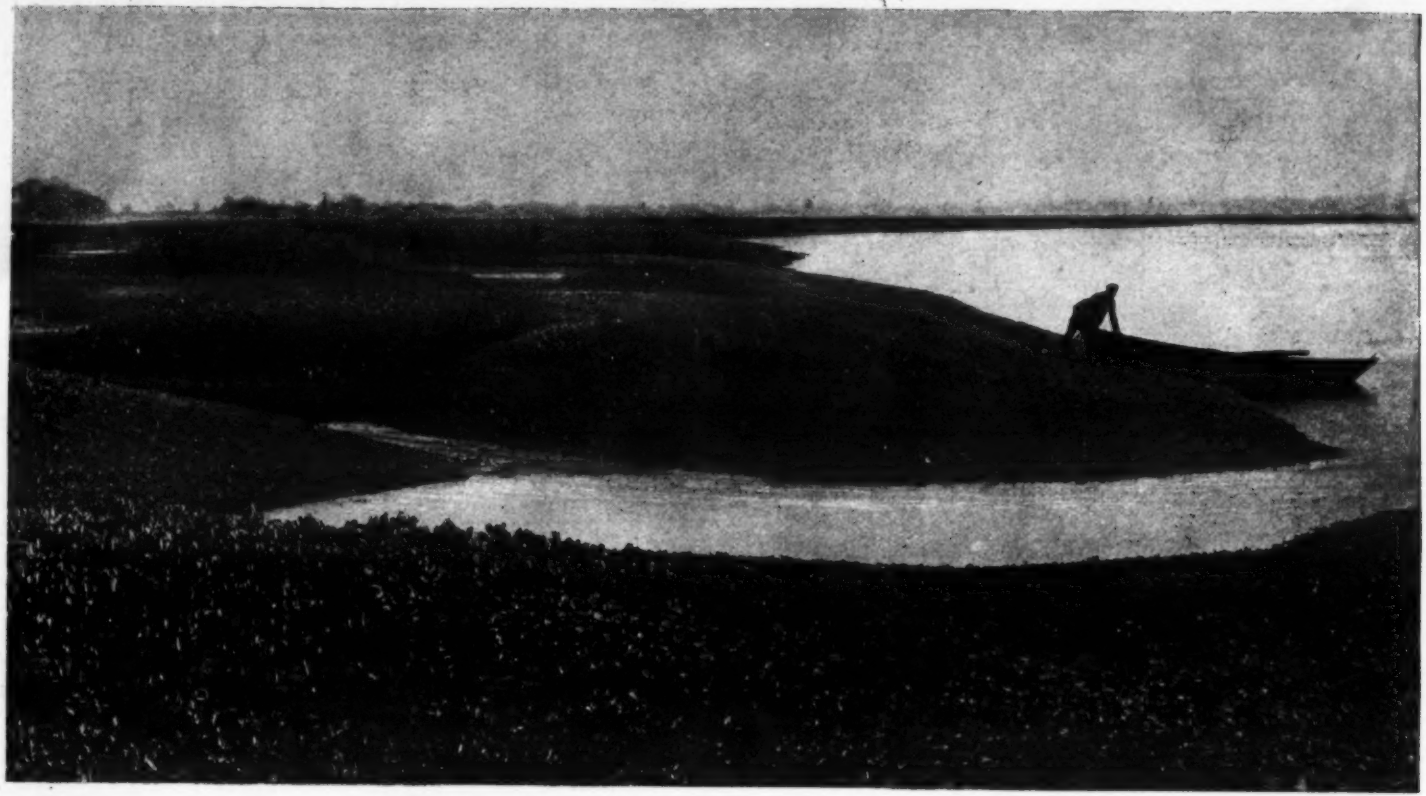

FIG. 1.—AN OYSTER FLAT IN SOUTH CAROLINA, SHOWING EXTENT OF RACCOON AREA.

and in the methods, number of persons, and capital employed for the building up of the industry.

In the present conditions an oyster famine is not a far-away nor impossible contingency. We have been large consumers of oysters, and we did not sow where we had reaped. Luckily, this condition of affairs attracted the serious attention of the United States Fish and Fisheries Commission; exhaustive investigations were made, and finally, in the autumn of 1891, Mr. Bashford Dean proceeded to France, under instructions from the United States Commissioner of Fish and Fisheries, and there, at the great French homes of oyster culture—around Arcachon and Auray—he examined the French methods of artificial culture, his observations being chiefly made so as to be as pertinent as possible to the conditions of American waters. I can not, however, agree with some of the statements which Mr. Dean makes in the introduction to his report. He says that, considering the condition and methods of oyster culture in France, it is apparent that in this country "all costly methods of cultivation could have proved of little practical value." Prof. W. K. Brooks, Mr. E. C. Blackford, and other authorities are positive in their statements to the contrary. For instance, in his report to the Legislature of New York State, in 1887, Mr. Blackford says: "The rapid deterioration of the natural growth of oyster beds . . . has made it absolutely necessary that the artificial propagation of the oyster should be encouraged to prevent its entire extermination." But, as it will be necessary to enter into this subject more fully later, I shall now briefly examine the general conditions of the industry as it exists to-day, making short historical and comparative allusions as I proceed.

Taking the oyster beds in the order in which I have placed them, we shall first examine those of South Carolina. "The entire coast margin" of this State is well provided with natural beds; but, says Mr. Dean, "they are strangely unlike the natural beds occurring further northward." In this region the oyster is found on the margin of the shore in positive reefs, part of which are at low tide exposed—so that the oysters live almost "as much in the air as in the water." These ledges are formed of curious clusters—those oysters which are on the top being called "raccoons," because of their peculiar shape. These oysters can barely be said to live, and are in their present condition utterly unfit for the table.

Prof. Ryder says that the cause of this peculiar clustering is that, because of the muddy and unhealthy condition of the bottom in the deeper water, the oysters of South Carolina cling to the shore line and there build upon one another, generation after generation, until sometimes ledges are formed over ten feet in

height. This crowding together prevents individual development, and consequently millions upon millions of oysters are lost to the people of this country in this one State alone. That the "planting" of "raccoon" seed in the deeper waters for cultivation would be profitless is shown by the natural growth of the oysters themselves in the marginal waters. They would soon become asphyxiated in the soft, silting mud bottom which occurs along the entire coast line of this State. But it has been demonstrated that, under almost as unfavorable conditions, excellent and healthy grounds could be prepared at comparatively slight cost, as has been so successfully done in Connecticut; and Mr. Dean shows conclusively that the "raccoons" might be scattered in "marginal waters about a fathom in depth," with an almost certain prospect of successful development. Curiously enough, in his article on the Biology of the Oyster Grounds of South Carolina, he *advocates* the artificial collection and rearing of spat.

There are miles upon miles of these "raccoon" ledges, and even islands which have been formed by the "raccoons," upon this part of the coast; they contain enough seedlings to stock the entire Atlantic coast, and a very little enterprise or judicious State interference would undoubtedly restore to South Carolina and the oyster-consuming population of the United States what must have been in ages past one of the most prolific natural oyster beds of the world.

The conditions in Chesapeake Bay are much more favorable than those which we have just considered. Here Nature has created, as Captain Collins has truly said, the most perfect oyster ground in the universe. But, as is the case with the prosecution of many other fisheries, man—either in his greed or ignorance, or both—has outraged a bountiful Nature by continuously fishing for the oysters without replanting, and as a consequence this remarkable oyster region is becoming rapidly less important.

In his report, Captain Collins accounts for the recklessness of the fishermen and oystermen in this way: "The general belief (in the Chesapeake Bay region) has been, that the natural wealth of the oyster beds is inexhaustible," and that, "trained from childhood to look upon the oyster grounds as their patrimony, . . . it is perhaps not remarkable that the fishermen of the Chesapeake have bitterly, and to this time successfully, opposed all attempts at legislation intended to convey proprietary rights in the grounds."

Illustrating their reliance upon Nature, the report just referred to quotes the following paragraph from a local publication: "The value of the oyster business alone to southeast Virginia is nearly $2,500,000 per annum. It is a crop constantly harvested, except in the months of May to August inclusive, and

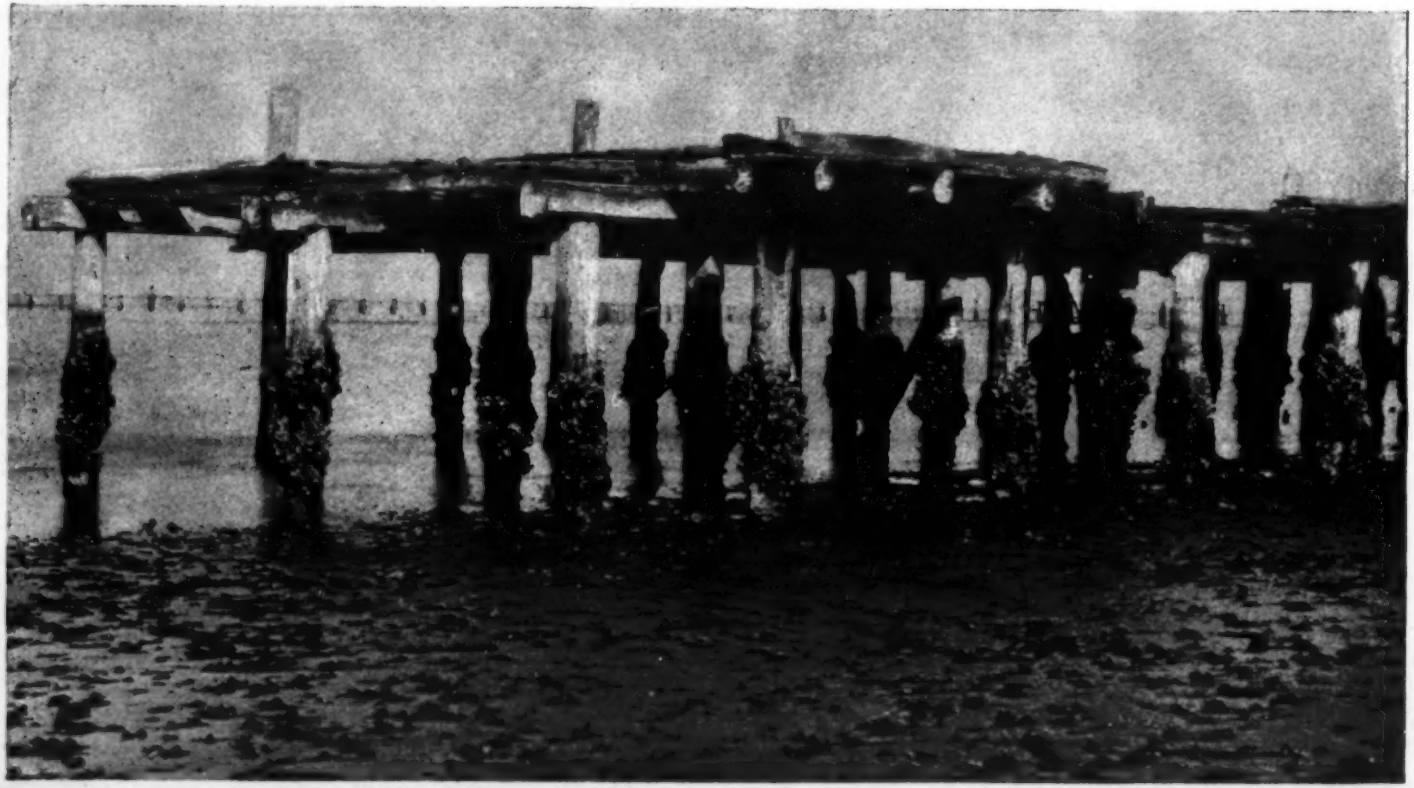

FIG. 2.—RACCOONS CLUSTERED ON THE PILING OF A WHARF AT HIGH-WATER MARK. Sullivan's Island, South Carolina.

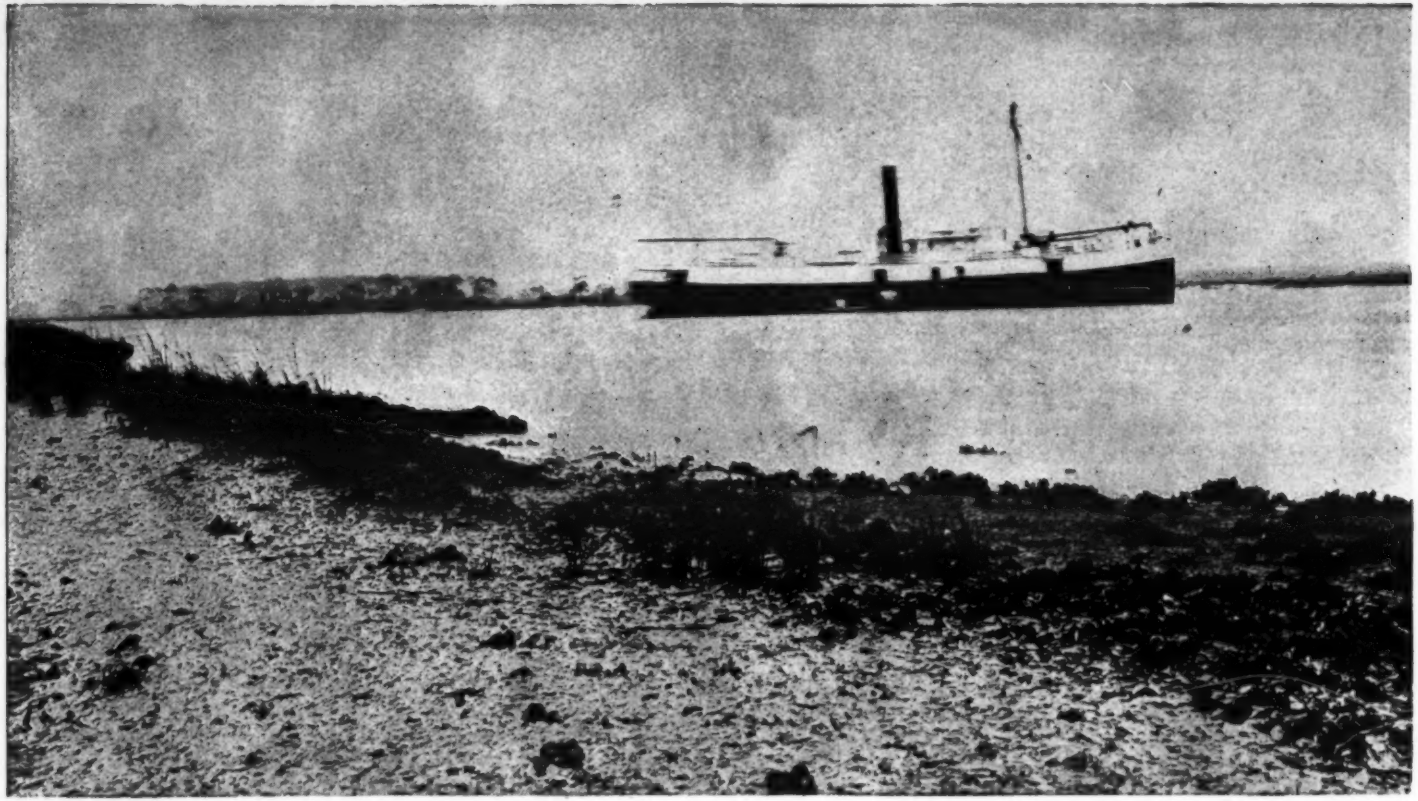

FIG. 3.—AN OYSTER LEDGE, SHOWING LIVING RACCOON OYSTERS FRINGING THE WATER.

is as constantly replenished by the bountiful hand of Nature." I have already shown how this same greed and ignorance of the Chesapeake oystermen have jeopardized not only their oyster supply but also their means of livelihood.

As a matter of fact it is in this erroneous assumption that lie the truth and reason for the apparent diminution of not only the oyster supply, but also the supplies of other fish food in our waters. Nature distinctly claims her rights when she demands that we must sow where we have reaped; and in this lies the true axis for the more satisfactory revolution of our fish and other food products.

I shall now pass to the third oyster ground which I have mentioned, and shall more pleasurably outline the prosperous conditions existing in Connecticut. Prior to 1784 no restrictions were placed upon the oyster fishery of this State; it was perfectly free, and as a consequence the beds soon became depleted. In that year the Legislature passed an enactment empowering every town of the State "to make rules and ordinances for regulating the fisheries of clams and oysters within their respective limits." This, however, did not materially aid in rehabilitating the beds; but the law continued in operation for seventy-one years—1855—when, the condition of the oyster grounds was so poor, a law was passed enabling private individuals to obtain two acres of ground for the *cultivation* of oysters. This was the first step in the right direction. The private owners discovered that, instead of planting small oysters, they could collect spat artificially on shells and other objects; this discovery "led to an extension of deep-water planting," and it was undeniably the source of the present prosperity of the Connecticut oyster fisheries.

Captain Collins says that at first the planting was confined to shallow waters; but, in 1865, many beds were planted "in as much as twenty feet of water." And so the development increased until 1874, when steam was introduced for dredging. In 1881 additional legislation became necessary, in order to enable the owners of private grounds to enlarge their territories, as they complained that the cultivation of oysters in deep waters required much additional and costly apparatus. And since that time the number of acres of oyster grounds owned by individuals —according to the Connecticut State Shellfish Commission—has increased from 33,987 acres in 1881 to 70,132 in 1889, of which 15,400 were planted. Apart from this calculation there are 19,911 acres of public oyster grounds—which, however, can not be dredged by steam.

In 1889 the value of oysters from natural beds amounted to only $31,305, whereas the yield of the cultivated beds was sold for $1,040,372. So that, if Connecticut relied upon her natural beds,

as do they in Maryland and Virginia, her oyster fisheries would have been a practical failure, as they threaten to be in the Chesapeake, unless there is speedy and judicious State legislation.

As a matter of fact, the present condition of affairs in the Chesapeake points ominously to a not far distant appeal from the fishermen of that region to the General Government to assist them in rehabilitating their oyster grounds. Such a contingency is at all times best avoided; but in this case I have shown, by comparison, that all that is needed in the Chesapeake region, to insure a renewed prosperity of the oyster fishery, is judicious State legislation in the direction of conveying proprietary rights to individuals or companies for the purpose of planting and cultivating the oyster. This plan has already been attempted in the Chesapeake, but has so far been successfully resisted by the fishermen. The prosperity of the Connecticut fisheries is entirely owing to the State enactments conferring proprietary rights; and there can not be a doubt but that similar legislation in Maryland and Virginia would bring about a return of prosperity to the Chesapeake oyster fisheries.

The usual method employed in Connecticut for the collection of spat is to first clean the ground by dredging and then cover it with shells, to which the spat will adhere, nearly 7,500,000 bushels of shells being used for this purpose during the past five years. "It is estimated that twenty-five or thirty adult oysters produce enough eggs each season to equal the annual product of Connecticut waters." So that, were it not for the starfish and other enemies which infest this coast, the supplies of food oysters would outrival in quantity the hundreds of thousands of acres covered by the now useless "raccoons" of South Carolina. No judicious expense is spared to make the oyster beds of Connecticut prolific: if they are too muddy, as are those of South Carolina, they are easily "made," by placing one hundred to two hundred tons of gravel over each acre, and the report of the commissioner states that "this system has produced excellent results."

Of course, there are other oyster grounds on the Atlantic coast besides those which I have mentioned—notably the famous Shrewsbury River beds; but they are not so extensive, nor do they so particularly affect the question, by comparison, of the advisability of adopting artificial propagation. And now, having briefly explained the conditions of our oyster grounds, we are brought face to face with the statement which prefaces this article, namely: "As the scarcity of seed is one of the greatest difficulties now encountered by the oyster planter," would the propagation of spat by artificial means profitably assist in rehabilitating our depleted grounds?

As I have already mentioned, Mr. Blackford not only thinks

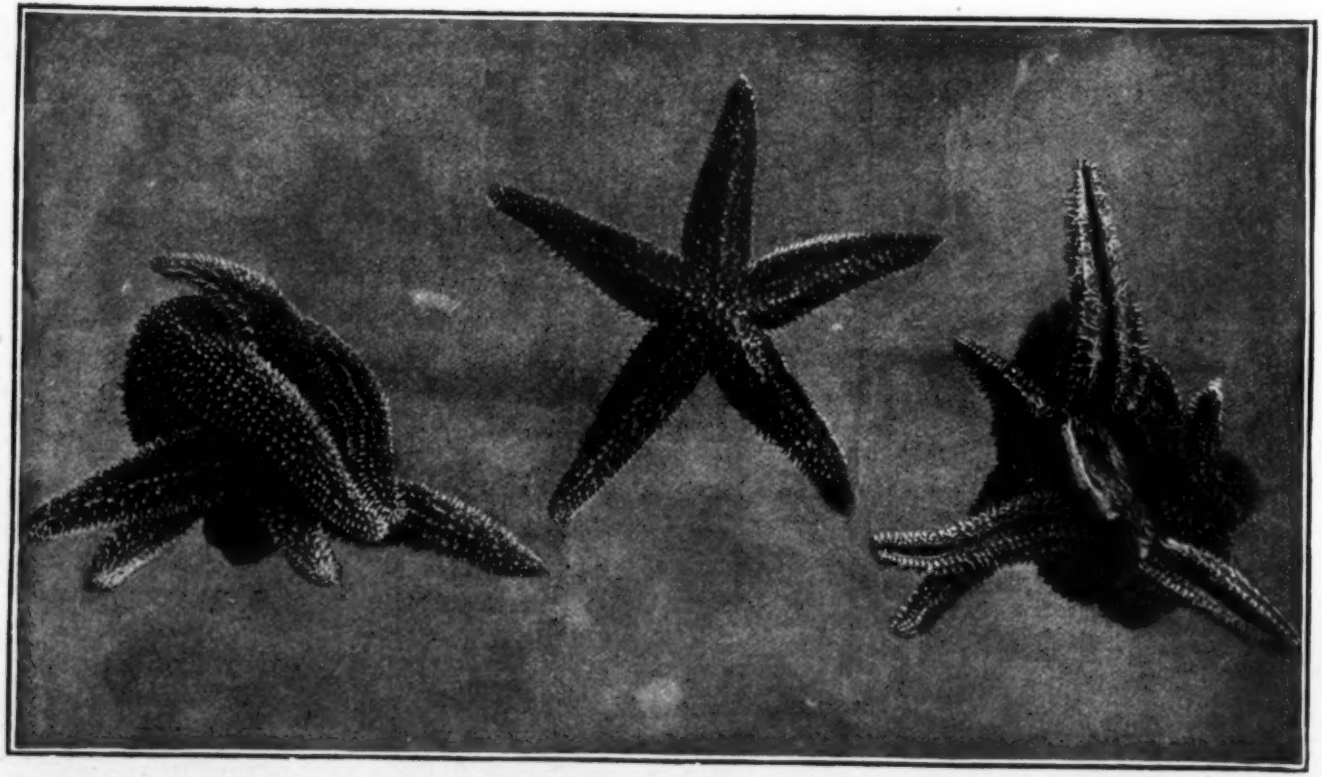

FIG. 4.—STARFISHES DESTROYING AN OYSTER.

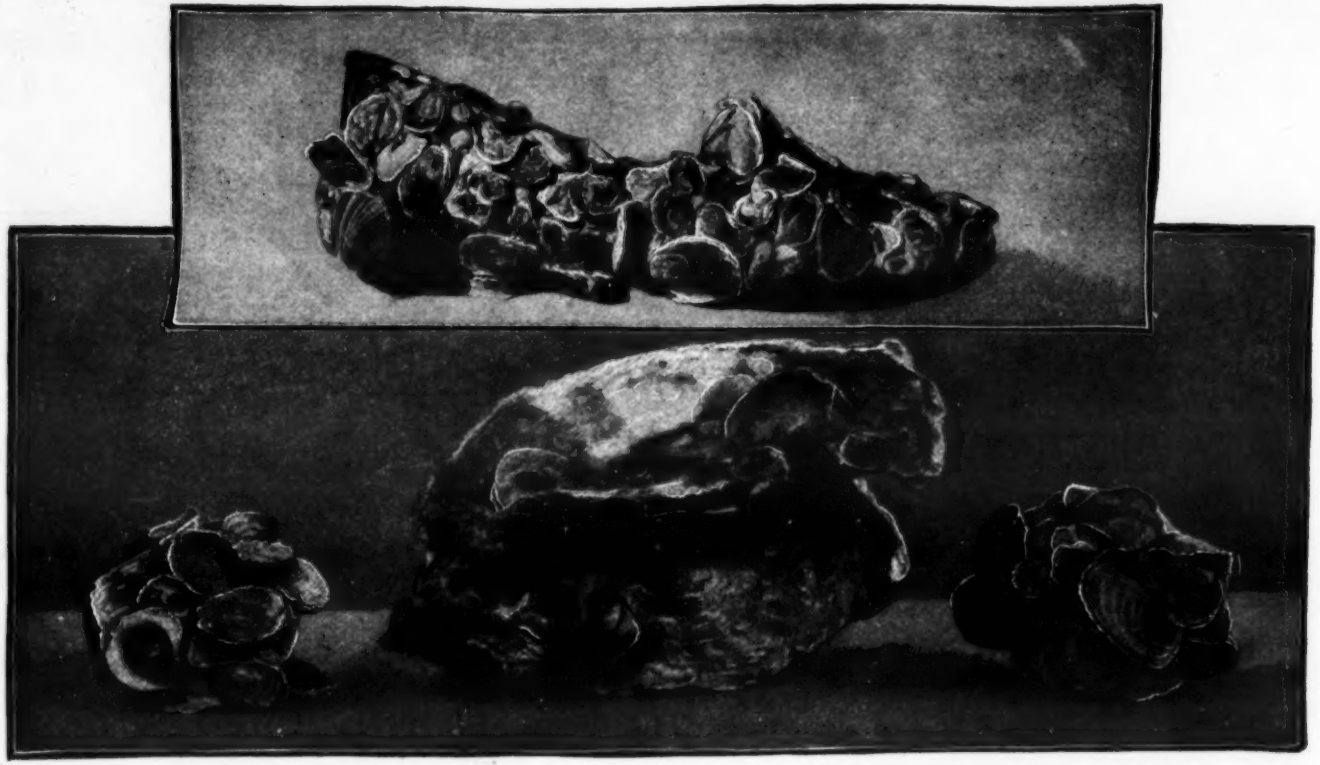

FIG. 5.—YOUNG OYSTERS (THREE TO SIX MONTHS OLD) SET ON SHELLS AND AN OLD RUBBER SHOE. From a photograph.

so, but says that the artificial propagation of the oyster "is absolutely necessary" to prevent its "entire extermination." In a report to the General Assembly of Maryland in 1887, Prof. Brooks also advocates the introduction of artificial propagation in these waters; Captain Collins suggests that such an experiment would be valuable; and Mr. Dean says that, although in this country "all costly methods of cultivation could have proved of little practical value, . . . enough has been said in this connection to show the necessity in practical oyster culture of collecting spat on floating collectors and of allowing it to attain, before planting, a considerable size." And notwithstanding all this testimony, Mr. Richard Rathbun, in the Report of the Commissioner of Fish and Fisheries for the year ending June 30, 1889, tells us that "the production of spat by aid of artificial methods has never been resorted to in this country, in consequence of the fact that the practical utility and economy of any proposed system has yet to be established." I should have thought that this matter could have been long since determined at the hatchery at Cold Spring Harbor, where, I have learned, such experiments have been successfully made. But, as the artificial propagation is not generally understood, and as it is extremely interesting, I shall briefly explain the most successful and general method employed in France; and I believe that the most obtuse reader will then see the feasibility of carrying on similar operations here.

The collection of the floating spat upon pieces of wood and stone is said to have been discovered by M. de Bon, Commissaire of Marine at St. Servan, France, in 1853; and we know that, when he announced his discovery, the matter was "at once taken up most enthusiastically by M. Coste," Professor of Embryology in the College of France. They undoubtedly drew public and scientific attention to this all-important branch of oyster culture; but I find that several years before the discovery of De Bon, the oystermen of the East River, New York, had not only made a similar discovery, but that they conceived the idea of utilizing it, and used *tiles* (a recent invention in French oyster culture) for collecting the spat, which they planted in the river and sound. Further, and in circumstantial proof of the statement, it is a fact that in 1855—the year when De Bon made his discovery—the Legislature of the State of New York enacted a law "to preserve to the private (oyster) farmers the fruits of their labor."

I am chiefly indebted to Mr. Bashford Dean's report on the Present Methods of Oyster Culture in France for the following brief description of the artificial propagation of the oyster in that country: The manner in which the spat or swimming oyster fry is obtained is very simple. Culturists place arched tiles, wooden trays, and other materials in the neighborhood of the natural

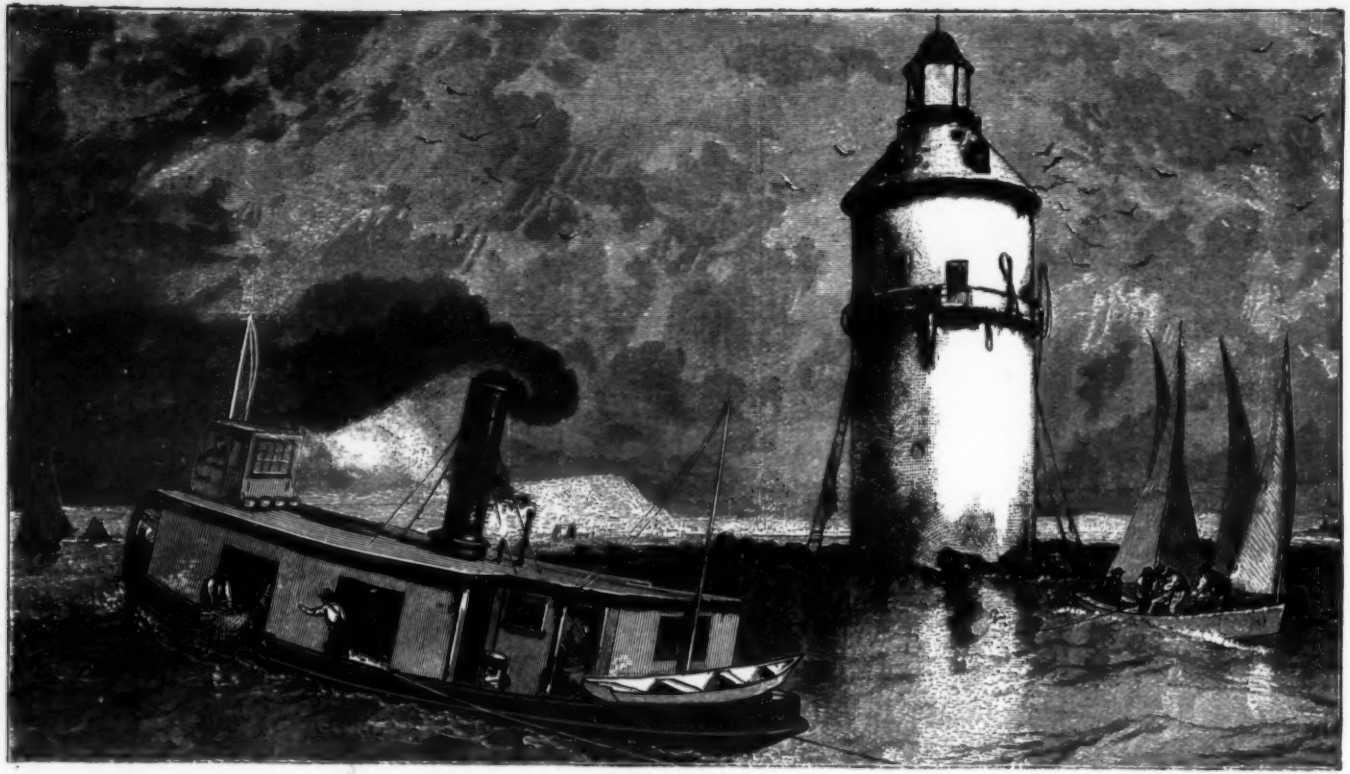

FIG. 6.—OYSTER-DREDGING IN LONG ISLAND SOUND.

banks about the 1st of July; the little spat at once cling to it, if they are anywhere near, and they are allowed to remain on

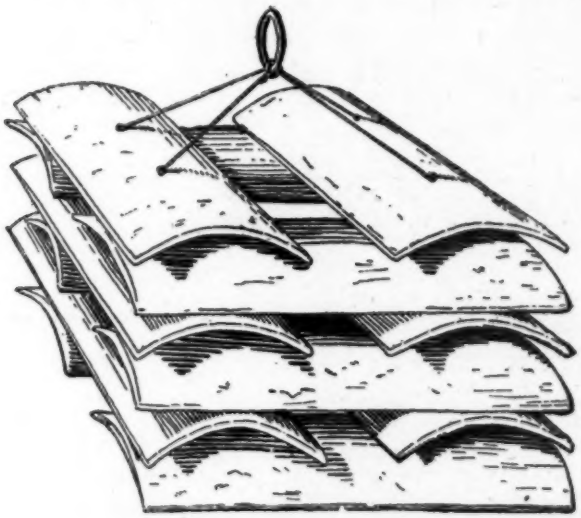

FIG. 7.—TILE COLLECTORS.

the tile until October, when they have attained "about the size of a finger nail." The tiles are then carefully placed upon lighters and floated ashore, where the seedling oysters are detached from them "by short pushes of a chisel-like knife." The spat usually

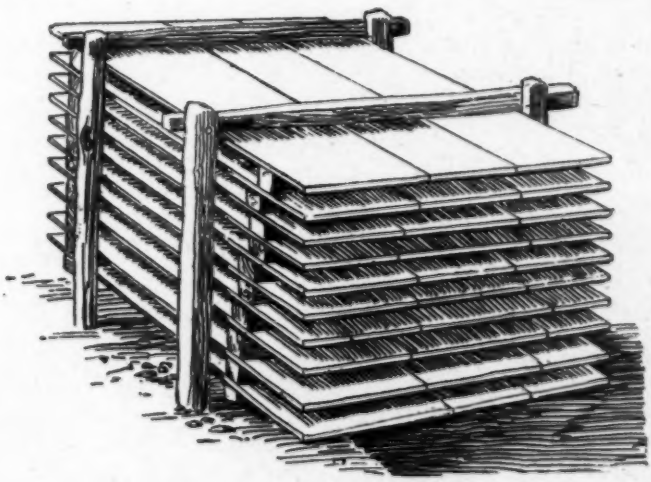

FIG. 8.—WOODEN-TRAY COLLECTORS.

averages on moderately clean ground about four hundred per tile, but as many as two thousand have been counted on one tile of fourteen inches by six.

The seed oysters having been removed from the tile or wood "collectors," they are taken to the low-water line and arranged in flat wire-gauze rearing cases, which "lift from the bottom and prevent the young from being stifled by the shiftings of mud; it also renders the growth regular and rapid, and, above all, it protects the oysters from their enemies," the starfishes, drills, etc. "During the first few months rapid growth renders it necessary to pick out each fortnight and transfer to other cases the largest oysters." This is generally done by women, who at the same time take out the dead shells. And so the process goes on

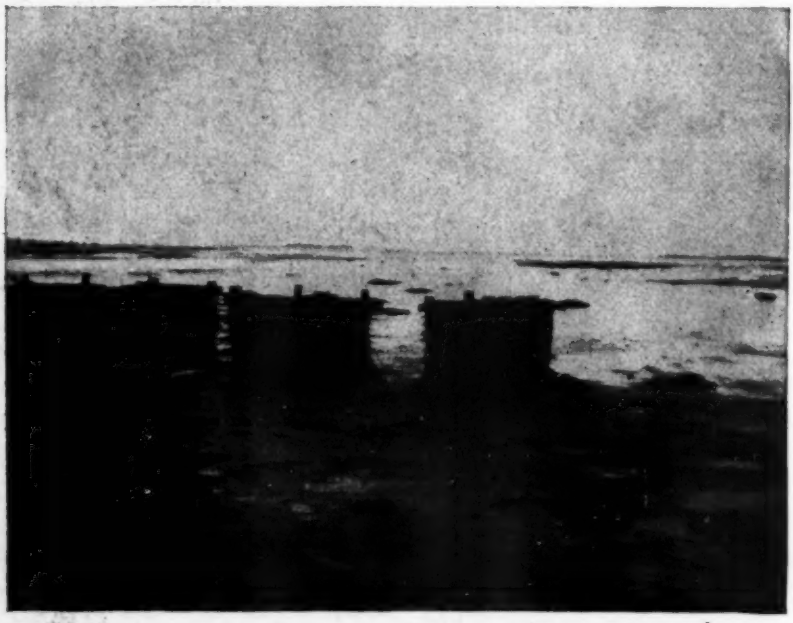

FIG. 9.—WOODEN TRAYS IN POSITION ON MACADAMIZED BOTTOM.

until the oyster is sufficiently grown for table use, usually two to three years.

Sometimes the river banks or beaches selected for the oyster-developing cages are soft and muddy; and here again the French culturist teaches us a lesson. He is not deterred by the unsuitable bottom; he at once macadamizes it with sand and gravel, giving a crust that is clean and serves admirably for cultural purposes.

Another method for collecting spat is in enclosed ponds provided with spawning oysters. Flood gates prevent the escape of the water, which is kept at "an average depth of about four feet." The same style of "collectors" that are used in the open sea "parks" (as each individual's holding is called) are used in these

FIG. 10.—EXAMINING A TILE COVERED WITH OYSTER SPAT.

ponds; but the result in the latter seems to be much more satisfactory. The pond, having been macadamized, is first thoroughly dried "for two months, . . . doing away with all animal and plant

FIG. 11.—DISENGAGING SEED OYSTERS FROM A TRAY COLLECTOR.

life"; then the water is let in gradually from the sea until the required depth is obtained. For ordinary evaporation a small quantity of *fresh* water is allowed to be introduced, but sometimes it becomes necessary to admit tide water. There are hundreds of ponds along our coast that could be utilized in the same manner as the one which I have just described, and a little care to observe a proper density and temperature of the water, after the inclosure and macadamizing had been done, is all that would be necessary to secure quite as satisfactory results as have been obtained in France.

Stringent regulations governing the dredging of the French natural oyster beds have succeeded in rehabilitating the depleted

FIG. 12.—CASES FOR REARING SEED OYSTERS AT CANCALE, FRANCE.

banks at Granville, St. Malo, and Cancale; and it appears to me that similarly stringent State enactments in Maryland and Virginia would immensely benefit the productivity of the Chesapeake grounds. "Dredging within the prescribed limits (in France), as at Cancale, is granted so seldom that such occasions have become like holidays." The time allowed in 1890 was "between two and three hours." Mr. Dean thus describes this annual dredging expedition: "The beach is filled with spectators. At a cannon shot the little vessels start as in a regatta, each striving to be first on the ground. The dredges, four or five to a boat, are operated by half a dozen fishers. A cannon shot closes the dredging, and the little fleet returns shoreward, usually well laden."

FIG. 13.—SORTING THE GROWING SEED OYSTERS AT ARCACHON.

This scene is precisely similar to that which takes place at the opening and closing of the great sturgeon fishing of the Don Cossacks in southern Russia, which I described, in an article on Sturgeon Fishing on the Don, in 1890.

FIG. 14.—THE CELEBRATED FRENCH OYSTER PARK AT BRENEGUY.

To sum up, I think I have proved that State interference is necessary for the protection of the natural oyster beds on the Atlantic coast; that the artificial propagation of spat would materially assist in providing an abundant supply of food oysters; that private ownerships in certain plots of marginal waters should be induced by protective State legislation, thus encouraging oyster planters and cultivators to invest their time and money in the industry; and that, unless speedy measures are taken in these directions and for a more general "planting" of seed oysters, something akin to an oyster famine is not measurably far away.

EVOLUTION AND ETHICS.*

By Prof. THOMAS H. HUXLEY, F. R. S.

I.

Soleo enim et in aliena castra transire, non tanquam transfuga, sed tanquam explorator. (L. Annæi Senecæ Epist. II, 4.) [For you must know I sometimes make an excursion into the enemy's camp, not by way of deserter, but as a spy.]

THERE is a delightful child's story, known by the title of Jack and the Bean-stalk, with which my contemporaries who are present will be familiar. But so many of our grave and reverend juniors have been brought up on severer intellectual diet, and perhaps have become acquainted with fairyland only through primers of comparative mythology, that it may be needful to give an outline of the tale. It is a legend of a bean-plant, which grows and grows until it reaches the high heavens, and there spreads out into a vast canopy of foliage. The hero, being moved to climb the stalk, discovers that the leafy expanse supports a world, composed of the same elements as that below, but yet strangely new; and his adventures there, on which I may not dwell, must have completely changed his views of the nature of things, though the story, not having been composed by or for philosophers, has nothing to say about views.

My present enterprise has a certain analogy to that of the daring adventurer. I beg you to accompany me in an attempt to reach a world which, to many, is probably strange, by the help of a bean. It is, as you know, a simple, inert-looking thing. Yet, if planted under proper conditions, of which sufficient warmth is one of the most important, it manifests active powers of a very remarkable kind. A small green seedling emerges, rises to the

* The Romanes Lecture, delivered in the Sheldonian Theatre, Oxford, May 18, 1893. Reprinted by the kind permission of Macmillan & Co.

surface of the soil, rapidly increases in size, and at the same time undergoes a series of metamorphoses which do not excite our wonder as much as those which meet us in legendary history, merely because they are to be seen every day, and all day long.

By insensible steps the plant builds itself up into a large and various fabric of root, stem, leaves, flowers, and fruit, every one molded, within and without, in accordance with an extremely complex, but at the same time minutely defined, pattern. In each of these complicated structures, as in their smallest constituents, there is an immanent energy which, in harmony with that resident in all the others, incessantly works toward the maintenance of the whole and the efficient performance of the part which it has to play in the economy of Nature. But no sooner has the edifice, reared with such exact elaboration, attained completeness than it begins to crumble. By degrees the plant withers and disappears from view, leaving behind more or fewer apparently inert and simple bodies, just like the bean from which it sprang, and, like it, endowed with the potentiality of giving rise to a similar cycle of manifestations.

Neither the poetic nor the scientific imagination is put to much strain in the search after analogies with this process of going forth and, as it were, returning to the starting point. It may be likened to the ascent and descent of a slung stone, or to the course of an arrow along its trajectory. Or we may say that the living energy takes first an upward and then a downward road. Or it may seem preferable to compare the expansion of the germ into the full-grown plant to the unfolding of a fan, or to the rolling forth and widening of a stream, and thus arrive at the conception of "development," or "evolution." Here, as elsewhere, names are "noise and smoke"; the important point is to have a clear and adequate conception of the fact signified by a name. And in this case the fact is the Sisyphæan process, in the course of which the living and growing plant passes from the relative simplicity and latent potentiality of the seed to the full epiphany of a highly differentiated type, thence to fall back to simplicity and potentiality.

The value of a strong intellectual grasp of the nature of this process lies in the circumstance that what is true of the bean is true of living things in general. From very low forms up to the highest—in the animal no less than in the vegetable kingdom—the process of life presents the same appearance * of cyclical evo-

* I have been careful to speak of the "appearance" of cyclical evolution presented by living things; for, on critical examination, it will be found that the course of vegetable and of animal life is not exactly represented by the figure of a cycle which returns into itself. What actually happens, in all but the lowest organisms, is that one part of the growing

lution. Nay, we have but to cast our eyes over the rest of the world and cyclical change presents itself on all sides. It meets us in the water that flows to the sea and returns to the springs; in the heavenly bodies that wax and wane, go and return to their places; in the inexorable sequence of the ages of man's life; in that successive rise, apogee, and fall of dynasties and of states which is the most prominent topic of civil history.

As no man, fording a swift stream, can dip his foot twice into the same water, so no man can with exactness affirm of anything in the sensible world that it is.* As he utters the words, nay, as he thinks them, the predicate ceases to be applicable; the present

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germ (*A*) gives rise to tissues and organs; while another part (*B*) remains in its primitive condition, or is but slightly modified. The moiety *A* becomes the body of the adult and, sooner or later, perishes, while portions of the moiety *B* are detached and, as offspring, continue the life of the species. Thus, if we trace back an organism along the direct line of descent from its remotest ancestor, *B*, as a whole, has never suffered death; portions of it only have been cast off and died in each individual offspring.

Everybody is familiar with the way in which the "suckers" of a strawberry plant behave. A thin cylinder of living tissue keeps on growing at its free end, until it attains a considerable length. At successive intervals it develops buds, which grow into strawberry plants; and these become independent by the death of the parts of the sucker which connect them. The rest of the sucker, however, may go on living and growing indefinitely, and, circumstances remaining favorable, there is no obvious reason why it should ever die. The living substance *B* in a manner answers to the sucker. If we could restore the continuity which was once possessed by the portions of *B*, contained in all the individuals of a direct line of descent, they would form a sucker, or *stolon*, on which these individuals would be strung, and which would never have wholly died.

A species remains unchanged so long as the potentiality of development resident in *B* remains unaltered; so long, e. g., as the buds of the strawberry sucker tend to become typical strawberry plants. In the case of the progressive evolution of a species, the developmental potentiality of *B* becomes of a higher and higher order. In retrogressive evolution the contrary would be the case. The phenomena of atavism seem to show that retrogressive evolution—that is, the return of a species to one or other of its earlier forms—is a possibility to be reckoned with. The simplification of structure which is so common in the parasitic members of a group, however, does not properly come under this head. The wormlike, limbless *Lernæa* has no resemblance to any of the stages of development of the many-limbed active animals of the group to which it belongs.

* Heracleitus says "Ποταμῷ γὰρ οὐκ ἔστι δὶς ἐμβῆναι τῷ αὐτῷ"; but, to be strictly accurate, the river remains though the water of which it is composed changes—just as a man retains his identity though the whole substance of his body is constantly shifting.

This is put very well by Seneca (Ep. lviii, 20, Ed. Ruhkopf): "Corpora nostra rapiuntur fluminum more, quidquid vides currit cum tempore; nihil ex his quæ videmus manet. Ego ipse dum loquor mutari ista, mutatus sum. Hoc est quod ait Heraclitus 'In idem flumen bis non descendimus.' Manet idem fluminis nomen, aqua transmissa est. Hoc in amne manifestius est quam in homine, sed nos quoque non minus velox cursus prætervehit." [Our bodies are carried away as a river: all that you see runs down with time: nothing still remains the same: even while I say these things are changed, I am changed myself. This is what Heraclitus means, when he says, "We go not twice into the same river." The river still keeps its name but the water passeth away. This indeed is more manifest in a river than in man; but yet as swift a course carries us likewise away.—*Morell's translation.*]

has become the past; the "is" should be "was." And the more we learn of the nature of things, the more evident is it that what we call rest is only unperceived activity; that seeming peace is silent but strenuous battle. In every part, at every moment, the state of the cosmos is the expression of a transitory adjustment of contending forces; a scene of strife, in which all the combatants fall in turn. What is true of each part is true of the whole. Natural knowledge tends more and more to the conclusion that "all the choir of heaven and furniture of the earth" are the transitory forms of parcels of cosmic substance wending along the road of evolution, from nebulous potentiality, through endless growths of sun and planet and satellite; through all varieties of matter; through infinite diversities of life and thought; possibly through modes of being of which we neither have a conception, nor are competent to form any, back to the undefinable latency from which they arose. Thus the most obvious attribute of the cosmos is its impermanence. It assumes the aspect not so much of a permanent entity as of a changeful process, in which naught endures save the flow of energy and the rational order which pervades it.

We have climbed our bean-stalk and have reached a wonderland in which the common and the familiar become things new and strange. In the exploration of the cosmic process thus typified, the highest intelligence of man finds inexhaustible employment; giants are subdued to our service; and the spiritual affections of the contemplative philosopher are engaged by beauties worthy of eternal constancy.

But there is another aspect of the cosmic process, so perfect as a mechanism, so beautiful as a work of art. Where the cosmopoietic energy works through sentient beings, there arises, among its other manifestations, that which we call pain or suffering. This baleful product of evolution increases in quantity and in intensity, with advancing grades of animal organization, until it attains its highest level in man. Further, the consummation is not reached in man, the mere animal; nor in man, the whole or half savage; but only in man, the member of an organized polity. And it is a necessary consequence of his attempt to live in this way; that is, under those conditions which are essential to the full development of his noblest powers.

Man, the animal, in fact, has worked his way to the headship of the sentient world, and has become the superb animal which he is, in virtue of his success in the struggle for existence. The conditions having been of a certain order, man's organization has adjusted itself to them better than that of his competitors in the cosmic strife. In the case of mankind, the self-assertion, the unscrupulous seizing upon all that can be grasped, the tenacious

holding of all that can be kept, which constitute the essence of the struggle for existence, have answered. For his successful progress, as far as the savage state, man has been largely indebted to those qualities which he shares with the ape and the tiger: his exceptional physical organization; his cunning, his sociability, his curiosity and his imitativeness; his ruthless and ferocious destructiveness when his anger is roused by opposition.

But, in proportion as men have passed from anarchy to social organization and in proportion as civilization has grown in worth, these deeply ingrained serviceable qualities have become defects. After the manner of successful persons, civilized man would gladly kick down the ladder by which he has climbed. He would be only too pleased to see "the ape and the tiger die." But they decline to suit his convenience; and the unwelcome intrusion of these boon companions of his hot youth into the ranged existence of civil life adds pains and griefs, innumerable and immeasurably great, to those which the cosmic process necessarily brings on the mere animal. In fact, civilized man brands all these ape and tiger promptings with the name of sins; he punishes many of the acts which flow from them as crimes; and, in extreme cases, he does his best to put an end to the survival of the fittest of former days by axe and rope.

I have said that civilized man has reached this point; the assertion is perhaps too broad and general; I had better put it that ethical man has attained thereto. The science of ethics professes to furnish us with a reasoned rule of life; to tell us what is right action and why it is so. Whatever difference of opinion may exist among experts, there is a general consensus that the ape and tiger methods of the struggle for existence are not reconcilable with sound ethical principles.

The hero of our story descended the bean-stalk, and came back to the common world, where fare and work were alike hard; where ugly competitors were much commoner than beautiful princesses; and where the everlasting battle with self was much less sure to be crowned with victory than a turn-to with a giant. We have done the like. Thousands upon thousands of our fellows, thousands of years ago, have preceded us in finding themselves face to face with the same dread problem of evil. They also have seen that the cosmic process is evolution; that it is full of wonder, full of beauty, and, at the same time, full of pain. They have sought to discover the bearing of these great facts on ethics; to find out whether there is, or is not, a sanction for morality in the ways of the cosmos.

Theories of the universe, in which the conception of evolution plays a leading part, were extant at least six centuries before our

era. Certain knowledge of them, in the fifth century, reaches us from localities as distant as the valley of the Ganges and the Asiatic coasts of the Ægean. To the early philosophers of Hindustan, no less than to those of Ionia, the salient and characteristic feature of the phenomenal world was its changefulness; the unresting flow of all things, through birth to visible being and thence to not being, in which they could discern no sign of a beginning and for which they saw no prospect of an ending. It was no less plain to some of these antique forerunners of modern philosophy that suffering is the badge of all the tribe of sentient things; that it is no accidental accompaniment, but an essential constituent of the cosmic process. The energetic Greek might find fierce joys in a world in which "strife is father and king"; but the old Aryan spirit was subdued to quietism in the Indian sage; the mist of suffering which spread over humanity hid everything else from his view; to him life was one with suffering and suffering with life.

In Hindustan, as in Ionia, a period of relatively high and tolerably stable civilization had succeeded long ages of semi-barbarism and struggle. Out of wealth and security had come leisure and refinement, and, close at their heels, had followed the malady of thought. To the struggle for bare existence, which never ends, though it may be alleviated and partially disguised for a fortunate few, succeeded the struggle to make existence intelligible and to bring the order of things into harmony with the moral sense of man, which also never ends, but, for the thinking few, becomes keener with every increase of knowledge and with every step toward the realization of a worthy ideal of life.

Two thousand five hundred years ago, the value of civilization was as apparent as it is now; then, as now, it was obvious that only in the garden of an orderly polity can the finest fruits humanity is capable of bearing be produced. But it had also become evident that the blessings of culture were not unmixed. The garden was apt to turn into a hothouse. The stimulation of the senses, the pampering of the emotions, endlessly multiplied the sources of pleasure. The constant widening of the intellectual field indefinitely extended the range of that especially human faculty of looking before and after, which adds to the fleeting present those old and new worlds of the past and the future, wherein men dwell the more the higher their culture. But that very sharpening of the sense and that subtle refinement of emotion which brought such a wealth of pleasures, were fatally attended by a proportional enlargement of the capacity for suffering; and the divine faculty of imagination, while it created new heavens and new earths, provided them with the corresponding hells of futile regret for the past and morbid anxiety for the

future.* Finally, the inevitable penalty of overstimulation, exhaustion, opened the gates of civilization to its great enemy, *ennui;* the stale and flat weariness when man delights not, nor woman neither—when all things are vanity and vexation, and life seems not worth living except to escape the bore of dying.

Even purely intellectual progress brings about its revenges. Problems settled in a rough-and-ready way by rude men, absorbed in action, demand renewed attention and show themselves to be still unread riddles when men have time to think. The beneficent demon, doubt, whose name is Legion and who dwells among the tombs of old faiths, enters into mankind and thenceforth refuses to be cast out. Sacred customs, venerable dooms of ancestral wisdom, hallowed by tradition and professing to hold good for all time, are put to the question. Cultured reflection asks for their credentials; judges them by its own standards; finally, gathers those of which it approves into ethical systems, in which the reasoning is rarely much more than a decent pretext for the adoption of foregone conclusions.

One of the oldest and most important elements in such systems is the conception of justice. Society is impossible unless those who are associated agree to observe certain rules of conduct toward one another; its stability depends on the steadiness with which they abide by that agreement; and, so far as they waver, that mutual trust which is the bond of society is weakened or destroyed. Wolves could not hunt in packs except for the real, though unexpressed, understanding that they should not attack one another during the chase. The most rudimentary polity is a pack of men living under the like tacit, or expressed, understanding; and having made the very important advance upon wolf society, that they agree to use the force of the whole body against individuals who violate it and in favor of those who observe it. This observance of a common understanding, with the consequent distribution of punishments and rewards according to accepted rules, received the name of justice, while the contrary was called injustice. Early ethics did not take much note of the animus of the violator of the rules. But civilization could not advance far

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* "Multa bona nostra nobis nocent, timoris enim tormentum memoria reducit, providentia anticipat. Nemo tantum præsentibus miser est." (Seneca, Ep. v, 7.) [Thus many things, really good in themselves, hurt us: for memory recalls and forecast anticipates the torment of fear. No one is wretched from what is present only.—*Morell's translation.*]

Among the many wise and weighty aphorisms of the Roman Bacon, few sound the realities of life more deeply than "Multa bona nostra nobis nocent." If there is a soul of good in things evil, it is at least equally true that there is a soul of evil in things good: for things, like men, have "les défauts de leurs qualités." It is one of the last lessons one learns from experience, but not the least important, that a heavy tax is levied upon all forms of success, and that failure is one of the commonest disguises assumed by blessings.

without the establishment of a capital distinction between the case of involuntary and that of willful misdeed—between a merely wrong action and a guilty one. And, with increasing refinement of moral appreciation, the problem of desert, which arises out of this distinction, acquired more and more theoretical and practical importance. If life must be given for life, yet it was recognized that the unintentional slayer did not altogether deserve death; and, by a sort of compromise between the public and the private conception of justice, a sanctuary was provided in which he might take refuge from the avenger of blood.

The idea of justice thus underwent a gradual sublimation from punishment and reward according to acts, to punishment and reward according to desert; or, in other words, according to motive. Righteousness—that is, action from right motive—not only became synonymous with justice, but the positive constituent of innocence and the very heart of goodness.

Now when the ancient sage, whether Indian or Greek, who had attained to this conception of goodness, looked the world, and especially human life, in the face, he found it as hard as we do to bring the course of evolution into harmony with even the elementary requirements of the ethical ideal of the just and the good.

If there is one thing plainer than another, it is that neither the pleasures nor the pains of life in the merely animal world are distributed according to desert, for it is admittedly impossible for the lower orders of sentient beings to deserve either the one or the other. If there is a generalization from the facts of human life, which has the assent of thoughtful men in every age and country, it is that the violator of ethical rules constantly escapes the punishment which he deserves; that the wicked flourishes like a green bay tree, while the righteous begs his bread; that the sins of the fathers are visited upon the children; that in the realm of Nature ignorance is punished just as severely as willful wrong; and that thousands upon thousands of innocent beings suffer for the crime or the unintentional trespass of one.

Greek and Semite and Indian are agreed upon this subject. The book of Job is at one with the "Works and Days" and the Buddhist Sutras; the Psalmist and the Preacher of Israel with the tragic poets of Greece. What is a more common motive of the ancient tragedy, in fact, than the unfathomable injustice of the nature of things? What is more deeply felt to be true than its presentation of the destruction of the blameless by the work of his own hands, or by the fatal operation of the sins of others? Surely Œdipus was pure of heart; it was the natural sequence of events—the cosmic process—which drove him, in all innocence,

to slay his father and become the husband of his mother, to the desolation of his people and his own headlong ruin. Or, to step for a moment beyond the chronological limits I have set myself, what constitutes the sempiternal attraction of Hamlet but the appeal to deepest experience of that history of a no less blameless dreamer, dragged, in spite of himself, into a world out of joint; involved in a tangle of crime and misery, created by one of the prime agents of the cosmic process as it works in and through man?

Thus, brought before the tribunal of ethics, the cosmos might well seem to stand condemned. The conscience of man revolted against the moral indifference of Nature and the microcosmic atoms hould have found the illimitable macrocosm guilty. But few, or none, ventured to record that verdict.

In the great Semitic trial of this issue, Job takes refuge in silence and submission; the Indian and the Greek, less wise perhaps, attempt to reconcile the irreconcilable and plead for the defendant. To this end, the Greeks invented Theodicies; while the Indians devised what, in its ultimate form, must rather be termed a Cosmodicy. For, though Buddhism recognizes gods many and lords many, they are products of the cosmic process; and transitory, however long enduring, manifestations of its eternal activity. In the doctrine of transmigration, whatever its origin, Brahmanical and Buddhist speculation found, ready to hand,* the

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* "There is within the body of every man a soul which, at the death of the body, flies away from it like a bird out of a cage, and enters upon a new life . . . either in one of the heavens or one of the hells or on this earth. The only exception is the rare case of a man having in this life acquired a true knowledge of God. According to the pre-Buddhistic theory, the soul of such a man goes along the path of the Gods to God and, being united with him, enters upon an immortal life in which his individuality is not extinguished. In the later theory, his soul is directly absorbed into the Great Soul, is lost in it and has no longer any independent existence. The souls of all other men enter, after the death of the body, upon a new existence in one or other of the many different modes of being. If in heaven or hell, the soul itself becomes a god or demon without entering a body; all superhuman beings save the great gods being looked upon as not eternal, but merely temporary creatures. If the soul returns to earth it may or may not enter a new body; and this either of a human being, an animal, a plant, or even a material object. For all these are possessed of souls, and there is no essential difference between these souls and the souls of men—all being alike mere sparks of the Great Spirit, who is the only real existence." (Rhys D[illegible] Hibbert Lectures, 1881, p. 83.)

For what I have said about Indian philosophy, I am particularly indebted to the luminous exposition of primitive Buddhism and its relations to earlier Hindu thought, which is given by Prof. Rhys Davids in his remarkable Hibbert Lectures for 1881, and Buddhism," (1890). The only apology I can offer for the freedom with which I have borrowed from him in these notes, is my desire to leave no doubt as to my indebtedness. I have also found Dr. Oldenberg's Buddha (Ed. 2, 1890) very helpful. The origin of the theory of transmigration stated in the above extract is an unsolved problem. That it differs widely from the Egyptian metempsychosis is clear. In fact, since men usually people the other

means of constructing a plausible vindication of the ways of the cosmos to man. If this world is full of pain and sorrow; if grief and evil fall, like the rain, upon both the just and the unjust; it is because, like the rain, they are links in the endless chain of natural causation by which past, present, and future are indissolubly connected; and there is no more injustice in the one case than in the other. Every sentient being is reaping as it has sown; if not in this life, then in one or other of the infinite series of antecedent existences of which it is the latest term. The present distribution of good and evil is, therefore, the algebraical sum of accumulated positive and negative deserts; or rather, it depends on the floating balance of the account. For it was not thought necessary that a complete settlement should ever take place. Arrears might stand over as a sort of "hanging gale"; a period of celestial happiness just earned might be succeeded by ages of torment in a hideous nether world, the balance still overdue for some remote ancestral error.*

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worlds with phantoms of this, the Egyptian doctrine would seem to presuppose the Indian as a more archaic belief.

Prof. Rhys Davids has fully insisted upon the ethical importance of the transmigration theory. "One of the latest speculations now being put forward among ourselves would seek to explain each man's character, and even his outward condition in life, by the character he inherited from his ancestors, a character gradually formed during a practically endless series of past existences, modified only by the conditions into which he was born, those very conditions being also, in like manner, the last result of a practically endless series of past causes. Gotama's speculation might be stated in the same words. But it attempted also to explain, in a way different from that which would be adopted by the exponents of the modern theory, that strange problem which it is also the motive of the wonderful drama of the book of Job to explain—the fact that the actual distribution here of good fortune, or misery, is entirely independent of the moral qualities which men call good or bad. We can not wonder that a teacher, whose whole system was so essentially an ethical reformation, should have felt it incumbent upon him to seek an explanation of this apparent injustice. And all the more so, since the belief he had inherited, the theory of the transmigration of souls, had provided a solution perfectly sufficient to any one who could accept that belief." (Hibbert Lectures, p. 93.) I should venture to suggest the substitution of "largely" for "entirely" in the foregoing passage. Whether a ship makes a good or a bad voyage is largely independent of the conduct of the captain, but it is as largely affected by that conduct. Though powerless before a hurricane, he may weather many a bad gale.

* "The outward condition of the soul is, in each new birth, determined by its actions in a previous birth; but by each action in succession and not by the balance struck after the evil has been reckoned off against the good. A good man, who has once uttered a slander, may spend a hundred thousand years as a god, in consequence of his goodness, and, when the power of his good actions is exhausted, may be born as a dumb man on account of his transgression; and a robber who has once done an act of mercy, may come to life in a king's body as a result of his virtue, and then suffer torments for ages in hell or as a ghost without a body, or be reborn many times as a slave or an outcast, in consequence of his evil life.

"There is no escape, according to this theory, from the result of any act; though it is only the consequences of its own acts that each soul has to endure. The force has been set in motion by itself and can never stop; and its effect can never be foretold. If evil, it can

Whether the cosmic process looks any more moral than at first, after such a vindication, may perhaps be questioned. Yet this plea of justification is not less plausible than others; and none but very hasty thinkers will reject it on the ground of inherent absurdity. Like the doctrine of evolution itself, that of transmigration has its roots in the world of reality; and it may claim such support as the great argument from analogy is capable of supplying.

Every-day experience familiarizes us with the facts which are grouped under the name of heredity. Every one of us bears upon him obvious marks of his parentage, perhaps of remoter relationships. More particularly, the sum of tendencies to act in a certain way, which we call "character," is often to be traced through a long series of progenitors and collaterals. So we may justly say that this "character"—this moral and intellectual essence of a man—does veritably pass over from one fleshly tabernacle to another and does really transmigrate from generation to generation. In the newborn infant, the character of the stock lies latent and the Ego is little more than a bundle of potentialities. But, very early, these become actualities; from childhood to age they manifest themselves in dullness or brightness, weakness or strength, viciousness or uprightness; and with each feature modified by confluence with another character, if by nothing else, the character passes on to its incarnation in new bodies.

The Indian philosophers called character, as thus defined, "karma."* It is this karma which passed from life to life and

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never be modified or prevented, for it depends on a cause already completed, that is now forever beyond the soul's control. There is even no continuing consciousness, no memory of the past that could guide the soul to any knowledge of its fate. The only advantage open to it is to add in this life to the sum of its good actions, that it may bear fruit with the rest. And even this can only happen in some future life under essentially the same conditions as the present one; subject, like the present one, to old age, decay, and death; and affording opportunity, like the present one, for the commission of errors, ignorances, or sins, which in their turn must inevitably produce their due effect of sickness, disability, or woe. Thus is the soul tossed about from life to life, from billow to billow, in the great ocean of transmigration. And there is no escape save for the very few who, during their birth as men, attain to a right knowledge of the Great Spirit: and thus enter into immortality, or, as the later philosophers taught, are absorbed into the Divine Essence." (Rhys Davids, Hibbert Lectures, pp. 85, 86.)

The state after death, thus imagined by the Hindu philosophers, has a certain analogy to the purgatory of the Roman Church; except that escape from it is dependent not on a divine decree modified, it may be, by sacerdotal or saintly intercession, but by the acts of the individual himself; and that while ultimate emergence into heavenly bliss of the good, or well-prayed for, Catholic is professedly assurred, the chances in favor of the attainment of absorption, or of Nirvana, by any individual Hindu are extremely small.

* "That part of the then prevalent transmigration theory which could not be proved false seemed to meet a deeply felt necessity, seemed to supply a moral cause which would explain the unequal distribution here of happiness or woe, so utterly inconsistent with the

linked them in the chain of transmigrations; and they held that it is modified in each life, not merely by confluence of parentage, but by its own acts. They were, in fact, strong believers in the theory, so much disputed just at present, of the hereditary transmission of acquired characters. That the manifestation of the tendencies of a character may be greatly facilitated, or impeded, by conditions, of which self-discipline, or the absence of it, are among the most important, is indubitable; but that the character itself is modified in this way is by no means so certain; it is not so sure that the transmitted character of an evil liver is worse, or that of a righteous man better, than that which he received. Indian philosophy, however, did not admit of any doubt on this subject; the belief in the influence of conditions, notably of self-discipline, on the karma was not merely a necessary postulate of its theory of retribution, but it presented the only way of escape from the endless round of transmigrations.

The earlier forms of Indian philosophy agreed with those prevalent in our own times, in supposing the existence of a permanent reality, or "substance," beneath the shifting series of phenomena, whether of matter or of mind. The substance of the cosmos was "Brahma," that of the individual man "Atman"; and the latter was separated from the former only, if I may so speak, by its phenomenal envelope, by the casing of sensations, thoughts and desires, pleasures and pains, which make up the illusive phantasmagoria of life. This the ignorant take for reality; their "Atman" therefore remains eternally imprisoned in delusions, bound by the fetters of desire and scourged by the whip of misery. But the man who has attained enlightenment sees that the apparent reality is mere illusion, or, as was said a couple

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present characters of men." Gautama "still therefore talked of men's previous existence, but by no means in the way that he is generally represented to have done." What he taught was "the transmigration of character." "Gotama held that after the death of any being, whether human or not, there survived nothing at all but that being's 'Karma,' the result, that is, of its mental and bodily actions. Every individual, whether human or divine, was the last inheritor and the last result of the Karma of a long series of past individuals—a series so long that its beginning is beyond the reach of calculation, and its end will be coincident with the destruction of the world." (Rhys Davids, Hibbert Lectures, p. 92.)

In the theory of evolution, the tendency of a germ to develop according to a certain specific type, e. g., of the kidney-bean seed to grow into a plant having all the characters of *Phaseolus vulgaris*, is its "Karma." It is the "last inheritor and the last result" of all the conditions that have affected a line of ancestry which goes back for many millions of years to the time when life first appeared on the earth. The moiety B of the substance of the bean plant (see note, p. 20), is the last link in a once continuous chain extending from the primitive living substance; and the characters of the successive species to which it has given rise are the manifestations of its gradually modified Karma. As Prof. Rhys Davids aptly says, the snowdrop "is a snowdrop and not an oak, and just that kind of snowdrop, because it is the outcome of the Karma of an endless series of past existences." (Hibbert Lectures, p. 114.)

of thousand years later, that there is nothing good nor bad but thinking makes it so. If the cosmos "is just and of our pleasant vices makes instruments to scourge us," it would seem that the only way to escape from our heritage of evil is to destroy that fountain of desire whence our vices flow; to refuse any longer to be the instruments of the evolutionary process and withdraw from the struggle for existence. If the karma is modifiable by self-discipline, if its coarser desires, one after another, can be extinguished, the ultimate fundamental desire of self-assertion, or the desire to be, may also be destroyed.* Then the bubble of illusion will burst, and the freed individual "Atman" will lose itself in the universal "Brahma."

Such seems to have been the pre-Buddhistic conception of salvation and of the way to be followed by those who would attain thereto. No more thorough mortification of the flesh has ever been attempted than that achieved by the Indian ascetic anchorite; no later monachism has so nearly succeeded in reducing the human mind to that condition of impassive *quasi*-somnambulism which, but for its acknowledged holiness, might run the risk of being confounded with idiocy.

And this salvation, it will be observed, was to be attained through knowledge, and by action based on that knowledge; just as the experimenter, who would obtain a certain physical or chemical result, must have a knowledge of the natural laws involved and the persistent disciplined will adequate to carry out all the various operations required. The supernatural, in our sense of the term, was entirely excluded. There was no external power which could affect the sequence of cause and effect which gives rise to karma; none but the will of the subject of the karma which could put an end to it.

Only one rule of conduct could be based upon the remarkable theory of which I have endeavored to give a reasoned outline. It

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* "It is interesting to notice that the very point which is the weakness of the theory—the supposed concentration of the effect of the Karma in one new being—presented itself to the early Buddhists themselves as a difficulty. They avoided it, partly by explaining that it was a particular thirst in the creature dying (a craving, Tanhā, which plays otherwise a great part in the Buddhist theory) which actually caused the birth of the new individual who was to inherit the Karma of the former one. But, how this took place, how the craving desire produced this effect, was acknowledged to be a mystery patent only to Buddha." (Rhys Davids, Hibbert Lectures, p. 95.)

Among the many parallelisms of Stoicism and Buddhism, it is curious to find one for this Tanhā, "thirst," or "craving desire" for life. Seneca writes (Epist. lxxvi, 18): "Si enim ullum aliud est bonum quam honestum, sequetur nos *aviditas vitæ* aviditas rerum vitam instruentium: quod est intolerabile infinitum, vagum." [Besides, was there any other good than what is right and fit, we should be persecuted with the desire of life, and an insatiable hankering after all the requisites thereto, which is intolerable, infinite, vague. —*Morell's translation.*]

was folly to continue to exist when an overplus of pain was certain, and the probabilities in favor of the increase of misery with the prolongation of existence were so overwhelming. Slaying the body only made matters worse; there was nothing for it but to slay the soul by the voluntary arrest of all its activities. Property, social ties, family affections, common companionship, must be abandoned; the most natural appetites, even that for food, must be suppressed, or at least minimized; until all that remained of a man was the impassive, extenuated, mendicant monk, self-hypnotized into cataleptic trances, which the deluded mystic took for foretastes of the final union with Brahma.

The founder of Buddhism accepted the chief postulates demanded by his predecessors. But he was not satisfied with the practical annihilation involved in merging the individual existence in the unconditioned—the Atman in Brahma. It would seem that the admission of the existence of any substance whatever—even of the tenuity of that which has neither quality nor energy and of which no predicate whatever can be asserted—appeared to him to be a danger and a snare. Though reduced to a hypostatized negation, Brahma was not to be trusted; so long as entity was there, it might conceivably resume the weary round of evolution, with all its train of immeasurable miseries. Gautama got rid of even that shade of a shadow of permanent existence by a metaphysical *tour de force* of great interest to the student of philosophy, seeing that it supplies the wanting half of Bishop Berkeley's well-known idealistic argument.

Granting the premises, I am not aware of any escape from Berkeley's conclusion, that the "substance" of matter is a metaphysical unknown quantity, of the existence of which there is no proof. What Berkeley does not seem to have so clearly perceived is that the non-existence of a substance of mind is equally arguable; and that the result of the impartial application of his reasonings is the reduction of the All to coexistences and sequences of phenomena, beneath and beyond which there is nothing cognoscible. It is a remarkable indication of the subtlety of Indian speculation that Gautama should have seen deeper than the greatest of modern idealists; though it must be admitted that, if some of Berkeley's reasonings respecting the nature of spirit are pushed home, they reach pretty much the same conclusion.*

* "The distinguishing characteristic of Buddhism was that it started a new line, that it looked upon the deepest questions men have to solve from an entirely different standpoint. It swept away from the field of its vision the whole of the great soul-theory which had hitherto so completely filled and dominated the minds of the superstitious and the thoughtful alike. For the first time in the history of the world, it proclaimed a salvation which each man could gain for himself and by himself, in this world, during this life, without any the least reference to God, or to gods, either great or small. Like the Upanishads, it placed

Accepting the prevalent Brahmanical doctrine that the whole cosmos, celestial, terrestrial, and infernal, with its population of gods and other celestial beings, of sentient animals, of Mara and his devils, is incessantly shifting through recurring cycles of pro-

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the first importance on knowledge; but it was no longer a knowledge of God, it was a clear perception of the real nature, as they supposed it to be, of men and things. And it added to the necessity of knowledge, the necessity of purity, of courtesy, of uprightness, of peace, and of a universal love far reaching, grown great and beyond measure." (Rhys Davids, Hibbert Lectures, p. 29.)

The contemporary Greek philosophy takes an analogous direction. According to Heracleitus, the universe was made neither by gods nor men; but, from all eternity has been, and to all eternity will be, immortal fire, glowing and fading in due measure. (Mullach, Heracliti Fragmenta, 27.) And the part assigned by his successors the Stoics, to the knowledge and the volition of the "wise man" made their Divinity (for logical thinkers) a subject for compliments, rather than a power to be reckoned with. In Hindu speculation the "Arahat," still more the "Buddha," becomes the superior of Brahma: the stoical "wise man" is, at least, the equal of Zeus.

Berkeley affirms over and over again that no idea can be formed of a soul or spirit: "If any man shall doubt of the truth of what is here delivered, let him but reflect and try if he can form any idea of power or active being; and whether he hath ideas of two principal powers marked by the names of *will* and *understanding* distinct from each other, as well as from a third idea of substance or being in general, with a relative notion of its supporting or being the subject of the aforesaid power, which is signified by the name *soul* or *spirit*. This is what some hold: but, so far as I can see, the words *will*, *soul*, *spirit*, do not stand for different ideas, or in truth for any idea at all, but for something which is very different from ideas, and which, being an agent, can not be like unto or represented by any idea whatever [though it must be owned at the same time, that we have some notion of soul, spirit, and the operations of the mind, such as willing, loving, hating, inasmuch as we know or understand the meaning of these words"]. (The Principles of Human Knowledge, lxxvi. See also §§ lxxxix, cxxxv, cxlv.)

It is open to discussion, I think, whether it is possible to have "some notion" of that of which we can form no "idea."

Berkeley attaches several predicates to the "perceiving active being mind, spirit, soul, or myself" (Part I, II). It is said, for example, to be "indivisible, incorporeal, unextended, and incorruptible." The predicate indivisible, though negative in form, has highly positive consequences. For, if "perceiving active being" is strictly indivisible, man's soul must be one with the Divine spirit; which is good Hindu or Stoical doctrine, but hardly orthodox Christian philosophy. If, on the other hand, the "substance" of active perceiving "being" is actually divided into the one Divine and innumerable human entities, how can the predicate "indivisible" be rigorously applicable to it?

Taking the words cited, as they stand, they amount to the denial of the possibility of any knowledge of substance. "Matter" having been resolved into mere affections of "spirit," "spirit" melts away into an admittedly inconceivable and unknowable hypostasis of thought and power—consequently the existence of anything in the universe beyond a flow of phenomena is a purely hypothetical assumption. Indeed, a pyrrhonist might raise the objection that if "esse" is "percipi" spirit itself can have no existence except as a perception, hypostatized into a "self" or as a perception of some other spirit. In the former case, objective reality vanishes; in the latter, there would seem to be the need of an infinite series of spirits each perceiving the others.

It is curious to observe how very closely the phraseology of Berkeley sometimes approaches that of the Stoics: thus (cxlviii): "It seems to be a *general pretense of the unthinking* herd that *they can not see God*. . . . But, alas! we need only open our eyes to see

duction and destruction, in each of which every human being has his transmigratory representative, Gautama proceeded to eliminate substance altogether; and to reduce the cosmos to a mere flow of sensations, emotions, volitions, and thoughts, devoid of any substratum. As on the surface of a stream of water we see

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the Sovereign Lord of all things with a more full and clear view than we do any of our fellow-creatures; . . . we do at all times and in all places perceive manifest tokens of the Divinity: everything we see, hear, feel, or any wise perceive by sense, being a sign or effect of the power of God." . . . cxlix. "It is therefore plain, that *nothing can be more evident* to any one that is capable of the least reflection, *than the existence of God*, or a spirit who is intimately present to our minds producing in them all that variety of ideas or sensations, which continually affect us, on whom we have an absolute and entire dependence, in short, *in whom we live and move and have our being*." cl. "[But you will say hath Nature no share in the production of natural things and must they be all ascribed to the immediate and sole operation of God? . . . if by *Nature* is meant some being distinct from God, as well as from the laws of Nature and things perceived by sense, I must confess that word is to me an empty sound, without any intelligent meaning annexed to it.] Nature in this acceptation is a vain *Chimæra* introduced by those heathens who had not just notions of the omnipresence and infinite perfection of God."

(Compare Seneca, De Beneficiis, iv, 7.)

"Natura, inquit, hæc mihi præstat. Non intelligis te, quum hoc dicis, mutare Nomen Deo? Quid enim est aliud Natura, quam Deus, et divina ratio, toti mundo et partibus ejus inserta? Quoties voles, tibi licet aliter hunc auctorem rerum nostrarum compellare, et Jovem illum optimum et maximum rite dices, et tonantem, et statorem: qui non, ut historici tradiderunt, ex eo quod post votum susceptum acies Romanorum fugientum stetit, sed quod stant beneficio ejus omnia, stator, stabilitorque est: hunc eundem et fatum si dixeris, non mentieris, nam quum fatum nihil aliud est, quam series implexa causarum, ille est prima omnium causa, ea qua cæteræ pendent." ["Nature," says my opponent, "gives me all this." Do you not perceive when you say this that you merely speak of God under another name, for what is Nature but God and divine reason, which pervades the universe and all its parts? You may address the author of our world by as many different titles as you please; you may rightly call him Jupiter, Best and Greatest, and the Thunderer, or the Stayer, so called, not because, as the historians tell us, he stayed the flight of the Roman army in answer to the prayer of Romulus, but because all things continue in their stay through his goodness. If you were to call this same personage Fate, you would not lie; for since fate is nothing more than a connected chain of causes, he is the first cause of all, upon which all the rest depend.—*Bohn's translation.*]

It would appear, therefore, that the good bishop is somewhat hard upon the "heathen," of whose words his own might be a paraphrase.

There is yet another direction in which Berkeley's philosophy, I will not say agrees with Gautama's, but at any rate helps to make a fundamental dogma of Buddhism intelligible.

"I find I can excite ideas in my mind at pleasure, and vary and shift the scene as often as I think fit. It is no more than willing, and straightway this or that idea arises in my fancy: and by the same power, it is obliterated, and makes way for another. This making and unmaking of ideas doth very properly denominate the mind active. Thus much is certain and grounded on experience. . . ." (Principles, xxviii.)

A good many of us, I fancy, have reason to think that experience tells them very much the contrary; and are painfully familiar with the obsession of the mind by ideas which can not be obliterated by any effort of the will and steadily refuse to make way for any others. But what I desire to point out is that if Gautama was equally confident that he could "make and unmake" ideas—then, since he had resolved self into a group of ideal phantoms—the possibility of abolishing self by volition naturally followed.

ripples and whirlpools, which last for a while and then vanish with the causes that gave rise to them, so what seem individual existences are mere temporary associations of phenomena circling round a center, "like a dog tied to a post." In the whole universe there is nothing permanent, no eternal substance either of mind or of matter. Personality is a metaphysical fancy; and, in very truth, not only we, but all things, in the worlds without end of the cosmic phantasmagoria, are such stuff as dreams are made of.

What then becomes of karma? Karma remains untouched. As the peculiar form of energy we call magnetism may be transmitted from a loadstone to a piece of steel, from the steel to a piece of nickel, as it may be strengthened or weakened by the conditions to which it is subjected while resident in each piece, so it seems to have been conceived that karma might be transmitted from one phenomenal association to another by a sort of induction. However this may be, Gautama doubtless had a better guarantee for the abolition of transmigration, when no wrack of substance, either of Atman or of Brahma, was left behind; when, in short, a man had but to dream that he willed not to dream, to put an end to all dreaming.

This end of life's dream is Nirvana. What Nirvana is the learned do not agree. But, since the best original authorities tell us there is neither desire, nor activity, nor any possibility of phenomenal reappearance for the sage who has entered Nirvana, it may be safely said of this acme of Buddhistic philosophy—the rest is silence.*

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* According to Buddhism, the relation of one life to the next is merely that borne by the flame of one lamp to the flame of another lamp which is set alight by it. To the "Arahat" or adept "no outward form, no compound thing, no creature, no creator, no existence of any kind, must appear to be other than a temporary collocation of its component parts fated inevitably to be dissolved." (Rhys Davids, Hibbert Lectures, p. 211.)

The self is nothing but a group of phenomena held together by the desire of life; when that desire shall have ceased "the Karma of that particular chain of lives will cease to influence any longer any distinct individual, and there will be no more birth; for birth, decay, and death, grief, lamentation, and despair will have come, so far as regards that chain of lives, forever to an end."

The state of mind of the Arahat in which the desire of life has ceased is Nirvana. Dr. Oldenberg has very acutely and patiently considered the various interpretations which have been attached to "Nirvana" in the work to which I have referred (p. 285 *et seq.*). The result of his and other discussions of the question may, I think, be briefly stated thus:

1. Logical deduction from the predicates attached to the term "Nirvana" strips it of all reality, conceivability, or perceivability, whether by gods or men. For all practical purposes, therefore, it comes to exactly the same thing as annihilation.

2. But it is not annihilation in the ordinary sense, inasmuch as it could take place in the living Arahat or Buddha.

3. And, since, for the faithful Buddhist, that which was abolished in the Arahat was the possibility of further pain, sorrow, or sin; and that which was attained was perfect peace;

Thus there is no very great practical disagreement between Gautama and his predecessors with respect to the end of action; but it is otherwise as regards the means to that end. With just insight into human nature, Gautama declared extreme ascetic practices to be useless and indeed harmful. The appetites and the passions are not to be abolished by mere mortification of the body; they must, in addition, be attacked on their own ground, and conquered by steady cultivation of the mental habits which oppose them; by universal benevolence; by the return of good for evil; by humility; by abstinence from evil thought; in short, by total renunciation of that self-assertion which is the essence of the cosmic process.

Doubtless it is to these ethical qualities that Buddhism owes its marvelous success.* A system which knows no God in the Western sense; which denies a soul to man; which counts the belief in immortality a blunder, and the hope of it a sin; which refuses any efficacy to prayer and sacrifice; which bids men look to nothing but their own efforts for salvation; which in its original purity knew nothing of vows of obedience, abhorred intolerance, and never sought the aid of the secular arm; yet spread over a considerable moiety of the Old World with marvelous rapidity, and is still, with whatever base admixture of foreign superstitions, the dominant creed of a large fraction of mankind.

[*To be concluded.*]

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his mind directed itself exclusively to this joyful consummation, and personified the negation of all conceivable existence and of all pain into a positive bliss. This was all the more easy, as Gautama refused to give any dogmatic definition of Nirvana. There is something analogous in the way in which people commonly talk of the "happy release" of a man who has been long suffering from mortal disease. According to their own views, it must always be extremely doubtful whether the man will be any happier after the "release" than before. But they do not choose to look at the matter in this light.

The popular notion that, with practical if not metaphysical annihilation in view, Buddhism must needs be a sad and gloomy faith, seems to be inconsistent with fact; on the contrary, the prospect of Nirvana fills the true believer, not merely with cheerfulness but with an ecstatic desire to reach it.

* The influence of the picture of the personal qualities of Gautama afforded by the legendary anecdotes which rapidly grew into a biography of the Buddha, and by the birth stories, which coalesced with the current folk lore and were intelligible to all the world, doubtless played a large part. Further, although Gautama appears not to have meddled with the caste system, he refused to recognize any distinction save that of perfection in the way of salvation among his followers; and, by such teaching, no less than by the inculcation of love and benevolence to all sentient beings, he practically leveled every social, political, and racial barrier. A third important condition was the organization of the Buddhists into monastic communities for the stricter professors, while the laity were permitted a wide indulgence in practice, and were allowed to hope for accommodation in some of the temporary abodes of bliss. With a few hundred thousand years of immediate paradise in sight, the average man could be content to shut his eyes to what might follow.

LAPLACE'S PLAN FOR PERPETUAL MOONLIGHT.

By DANIEL KIRKWOOD.

ONE of the questions considered by Laplace in the early part of the century, and which he thought of sufficient interest to have a place in his System of the World, has dropped almost wholly out of view. I refer to the relation of the moon to the earth—what it is and what it might have been. The subject is not even referred to in any recent text-book on astronomy. The conclusion of Laplace, however, was not hastily reached, and it remained in his hands, without modification, for a number of years. The great name of the author probably prevented astronomers of the day from undertaking any criticism of his conclusions, and especially from the expression of any opinion on a mathematical question different from that of the greatest astronomer of the century. If Laplace himself ever saw his mistake he never mentioned it, as in the case of a mathematical error pointed out by Dr. Bowditch, the translator of the Mécanique Céleste. Dr. Bowditch's letter informing him of the error was never acknowledged. The mistake, however, was rectified in a new edition. But I proceed with the subject.

If moonlight, it has been said, be always pleasant and desirable—if it contribute to the convenience and enjoyment of life, and if its perpetuity be not inconsistent with the laws by which the world is governed—why has its use been so largely denied us? Why has Nature, or the Author of Nature, left us so great a portion of our time in almost total darkness? Such questions have doubtless occurred to thoughtful minds in all ages. The subject is one of interest and curiosity. Let us briefly consider some of the possible relations of a satellite to its primary, including a special case proposed by Laplace.

Sir Isaac Newton, who preceded Laplace by about a century, had found evidence, as he claimed, that the material universe is the work of an all-wise designer. The author of the Mécanique Céleste, the greatest mathematical astronomer of his age, seldom discussed questions of a moral nature; but, not accepting Newton's views on the doctrine of final causes, or the doctrine of design in the material world, he took occasion to point out a so-called failure of Nature in adapting means to ends. If the moon was designed to give light by night, the purpose, he said, had largely failed, and he (Laplace) could suggest a better plan. But the entire passage is quoted as follows:

"Some partisans of final causes have imagined that the moon was given to the earth to afford it light during the night. But in this case Nature would not have attained the end proposed, since

we are often deprived at the same time of the light of both sun and moon. To have accomplished this end, it would have been sufficient to have placed the moon at first in opposition to the sun and in the plane of the ecliptic, at a distance from the earth equal to the one hundredth part of the distance of the earth from the sun, and to have impressed on the earth and moon parallel velocities proportional to their distances from the sun. In this case, the moon, being constantly in opposition to the sun, would have described round it an ellipse similar to that of the earth. These two bodies would then constantly succeed each other, and as at this distance the moon could not be eclipsed, its light would always replace that of the sun." *

The plan here proposed was one of startling boldness; but without assuming to defend the doctrine of final causes, it must be said in fairness that to afford light by night had never been claimed as the *only* design for which the moon was given. Other purposes no less important may be readily imagined. Moreover, the moon's light at the distance named by Laplace would have been little more than one twentieth part of that afforded by the full moon at its actual distance, or less than that of our new moon two days after the change. Such moonlight, though perpetual, would have had little comparative value. Again, the tidal effect upon the earth would have been scarcely perceptible. But without further insisting on these points, however important, let us compare the proposed arrangement with that of Nature. Would it have involved nothing inconsistent with the system's stability? or would its adoption have resulted in depriving our world of the moonlight enjoyed in the existing system?

The annexed figure † illustrates Laplace's proposed arrangement. The distance at which he would have placed the moon from the earth is about 1,000,000 miles, or a little more than four times the actual distance. An eclipse of the moon is caused by its falling into the earth's shadow. This can extend into space only about 860,000 miles, and, as this is less than the distance of Laplace's proposed moon, the latter, as he remarks, could never be eclipsed.

Let us suppose the distance of the moon from the earth to be increased, what changes would be effected in the observed phenomena? At 478,000 miles, twice the present distance, the length of the lunar month would be seventy-seven days; the quantity of moonlight would be one fourth of what we now enjoy; and the height of tides in the open seas would be but a few inches. At 717,000 miles, three times the present distance, the length of the month would be one hundred and forty-two days, and the appar-

* Système du Monde, Hart's translation, vol. ii, p. 79. † Figure omitted.

ent size of the moon would be reduced to one ninth of its present value. With increasing distance the phenomena would still further change, till at the orbit named by Laplace the month would be equal to the year, and the moon's enlightened hemisphere would be turned constantly to the earth. But the great astronomer's dream of perpetual moonlight—how long would it be realized?

Another question of vital importance is here involved in the theory under consideration—the variation of the earth's attraction on the moon supposed to be removed to a greater distance. This variation is more rapid than that of the sun's attractive force on the same body, as the distance between the sun and moon is four hundred times that between the moon and the earth. At what point, then, would our satellite escape from the earth's controlling influence and commence to revolve as an independent planet about the sun? This question, strangely enough, seems never to have received Laplace's consideration; at least his statement was continued without change in a later edition of his Système du Monde. This problem touching the moon's limit of stability was not solved until sixteen years after Laplace's death.*

The relative distances as well as the direction and force of the impulses necessary to produce the required motions in the scheme of Laplace were given by himself in the paragraph quoted. The state of things at double the moon's distance has also been estimated. At four times the distance, or somewhat more, we find Laplace's position of perpetual moonlight; but just here we find the region where the earth loses its control over the moon's motion. The moon escapes from the *earth's* influence, and henceforth owns allegiance only to the sun. She becomes a *primary* planet, with a year somewhat greater than ours and a day of doubtful length. As regards the earth, lunar tides can no longer exist. Moonlight and the moon would forsake us together; and the new condition of things, could it be realized, would be worse than the first.

From the case here considered we may learn (1) that dogmatism in regard to the divine plan in the structure and constitution of the universe is not always wise. Final causes may engage the attention of thoughtful minds, but who shall set limits to their extent or application? "Touching the Almighty," said Elihu, "we can not find him out." (2) The wisdom manifested in the adaptations of material things around us transcends that of man's highest efforts. Attempts to disparage the skill of Nature's handiwork must end in failure and disappointment.

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* The solution was first given by M. Liouville in 1842.

The failure of the theory proposed in the case of the earth and moon is no less striking when applied to Mars, Jupiter, or any other planet. In every instance the position of the satellite assumed to afford permanent moonlight would be one of instability. This striking fact renders the oversight of Laplace the more remarkable. It may be stated, however, that by the arrangement of several moons about the same planet almost, if not entirely, perpetual moonlight might be possible. The system of Jupiter and his moons furnishes a clear illustration.

In conclusion, we have seen, then, that where one of the greatest mathematicians of all time suggested a change—a so-called improvement in the system of the world—the modification would have left us without tides, or, worse still, the earth in the system proposed would have lost control of her satellite, and we would not only have been deprived of moonlight, but also of the moon itself.

ELECTRICITY AT THE WORLD'S FAIR.

By CHARLES M. LUNGREN.

II.

THE facility with which a high temperature may be obtained with electricity, and the heat controlled and located just where it is wanted, makes this agent peculiarly well adapted to the heating of metals for welding and forging purposes. This was early recognized by Prof. Elihu Thomson, to whom the development of the art is chiefly due, and who has devised a great variety of apparatus capable of performing all classes of work, from the simple welding of two wires to the making of large and complicated joints.

The principle involved is very simple. If a current be passed through a rod or wire, heat will be developed in it if the current be of sufficient volume. If this circuit, instead of being formed of a continuous conductor, be a broken one, such as would be furnished by two rods whose ends abut, the heat will be developed first at the surface of con'act, as this is the point of greatest resistance, and then spread along the rods. And if, while the rods are in a heated condition, they be pressed together, they will become strongly united and form a perfect joint. On account of the radiation of heat from the surface and the cooling effect of the air, the rods become hotter at the center than at the surface, which is the reverse of what happens with a forge-heated bar, where the heating begins at the outside and gradually extends to the interior. This feature of the electric welding process has an important advantage in producing a firmer and more perfect joint, and

in diminishing the formation of surface scale. Tests show that the electric weld is much stronger than that made in the ordinary way in a forge, and, indeed, is in some cases stronger than other parts of the bar.

The machines designed by Prof. Thomson for carrying out this method of welding are extremely simple, the mechanical part consisting essentially of one or more pairs of clamps to hold the pieces to be united, and means for pressing them together while in a heated condition. In operating the machines the current is turned on by the workman by means of a switch; but Prof. Thomson has taken advantage of the movement of the pieces toward each other while the weld is being made to break the circuit, thus rendering the operation automatic and insuring the equal heating of the welded pieces. In machines for wire and small rod the welded wires and rods are pressed together by means of springs, but in those for larger work the necessary pressure is applied by hydraulic apparatus. The necessity for this will be appreciated when it is stated that the pressure requisite for steel is 1,800 pounds to the square inch, that for iron 1,200 pounds, and for copper 600 pounds.

Electrically the apparatus is as simple as it is mechanically. The alternating current, which has shown itself so flexible in the hands of the engineer in other departments of electrical work, is here called into requisition. Through the medium of converters the high potential machine current is transformed into others of great volume and low voltage suitable for this class of work. Currents of this character are rendered necessary by reason of the fact that all metals are very good conductors of electricity, and can therefore be heated only by currents of great amount. These currents range, in fact, from a few hundred ampères to eight and ten thousand. The voltage, however, is very low, rarely being more than four or five volts, and in large and heavy work sometimes not more than a single volt. On account of this very low electrical pressure all danger from the current is eliminated and the apparatus may be handled with the same freedom as any ordinary metal-working machine. In the distribution of the electrical appliances the current is usually generated by a machine conveniently located with reference to the source of power, and the current carried by wires to the welders, where the transformation takes place, each welder being provided with its own converter, proportioned so as to supply the character of current best suited to the special work of the machine. The current is under perfect control by means of regulating devices operated by the workman, the usual device employed being a reactive coil. The range of work possible with this method of welding is very great. It not only may be used in forming all ordinary welds with iron and steel, but

has been found capable of welding metals which have heretofore resisted all attempts to unite them direct, and which have therefore had to be brazed or soldered. Wrought iron, copper, brass,

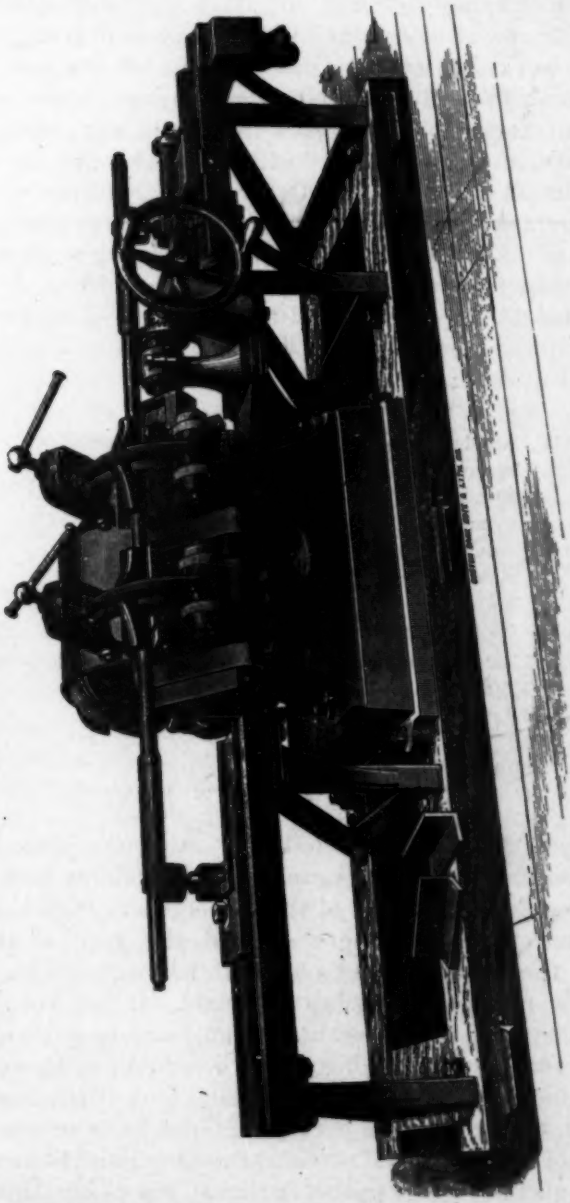


FIG. 8.—CARRIAGE-AXLE WELDER.

silver, platinum, gold, aluminum, and even cast iron may not only be welded together, but may also be welded to one another in many different combinations. In addition to welding, all sorts of brazing may be done by this method, as the same heat which

will soften a metal sufficiently to allow it to be welded will, of course, render the various solders fluid.

The process is, moreover, on account of the extreme rapidity with which welds may be made, and the ability to concentrate all the heat at the point of union, a very economical one. Practical commercial work has shown that the cost of the coal burned under the boiler to produce the electricity is just about that of the coal used in a forge to do the work in the old way, and that the saving in time, and hence labor cost, is clear gain, to say nothing of the cleanliness of the process, the freedom from deleterious materials in contact with the metal, such as sulphur and ash, and the advantage of having the work always in clear view. How great the saving in time is may be appreciated by the following statement of actual work vouched for by Mr. Frederick P. Royce and cited in a paper read by him before the National Association of Carriage Builders:

Axle Welding.

1″	round	axle	requires	25	horse	power	for	45 seconds.
1″	square	"	"	30	"	"	"	48 "
1¼″	round	"	"	35	"	"	"	60 "
1¼″	square	"	"	40	"	"	"	70 "
2″	round	"	"	75	"	"	"	95 "
2″	square	"	"	90	"	"	"	100 "

Tire Welding.

1″ × $\frac{5}{16}$	tire	requires	11	horse	power	for	15	seconds.
1¼″ × $\frac{3}{8}$″	"	"	23	"	"	"	25	"
1½″ × $\frac{3}{8}$″	"	"	23	"	"	"	30	"
1½″ × $\frac{1}{2}$″	"	"	23	"	"	"	40	"
2″ × $\frac{1}{2}$″	"	"	29	"	"	"	55	"
2″ × $\frac{3}{4}$″	"	"	42	"	"	"	62	"

The process, though only introduced into commercial work in 1888, has gone largely into use, and electric welders now form a part of the regular equipment of the carriage and bicycle factory, the boiler and tool shop, the wire mill, the yard of the shipbuilder, and the thousand and one establishments which have to do with the working and shaping of metals. It has been applied with marked success to the joining of the parts of railway frogs, of chairs to rails, and other heavy work, and in ordnance work, to the manufacture of shell and shrapnel. One of the most novel uses to which the process has been put is now to be seen in Boston on a section of the West End street railroad. This is the welding of the ends of the rails together without removing them from their places in the track, the object being to render the line of rails efficient return conductors for the current used with the trolley cars. To accomplish this the necessary apparatus is mounted upon a car provided with driving motors to enable it to

be moved along the track as the work proceeds. The current to supply both the motors and the converters is taken from the line wire by the ordinary trolley arm. In making the weld the earth is removed from about the joint, clamps applied, and the current sent through the rail ends until these are brought to a welding heat.

Another method of utilizing the electric current in the working of metals shown by the Thomson Company is due to M. de

FIG. 9.—TIRE WELDER.

Meritens, a well-known French inventor and constructor of dynamos. This consists in forming an arc between the object to be heated and a movable electrode carried in the hand of the operator. In this case the work forms one terminal of the electric circuit and the hand tool the other. This hand tool consists simply of a stick of ordinary arc-light carbon mounted in a suitable holder, and connected with the circuit by a flexible cable.

The workman is by this simple device provided with a tool of remarkable range and flexibility. He has at his command the enormous temperature of the electric arc, yet in such a form that he can vary it from the heat of a taper to full intensity, and reach with it parts of his work that would otherwise be inaccessible.

It is chiefly used at present in forming the longitudinal seams of tubes and vessels, and in filling in blow holes and other imperfections in castings. In this latter operation additional pieces of metal are fused into the openings, rendering the castings as sound and good as though they had come from the mold in perfect condition.

A method of using the electric current, substantially the same as that of Thomson, is employed by Mr. George D. Burton, and shown in operation at the exhibition by the Electrical Forging Company. Mr. Burton's object is not, however, to heat the metal simply at the line of juncture and then complete the union of the parts in one operation, but to heat a piece of metal either throughout its entire length or any particular part, and then forge it into shape by the hammer or special machines designed to produce particular forms. He uses, as in the Thomson apparatus, the alternating current transformed to one of great volume and low voltage; but instead of employing a number of converters, each adapted to the special work in hand, he makes one large one suffice, tapping this at as many points as desired. The holding device for the bars to be heated consists merely of a massive pair of copper clamps easily manipulated by the workman, and from which the work may be quickly transferred to the anvil or shaping machine.

The economy in time of electric heating is very strikingly shown where long bars and rods are heated. For instance, a round bar of tool steel, seven eighths of an inch in diameter and eleven inches long between the clamps of the machine, may be brought to a welding heat in one minute by the expenditure of thirty-two horse power. A bar of the same material, half an inch in diameter and five inches long, requires but twenty-seven and a half horse power for half a minute; while one an inch square and twelve inches long is raised to a white heat by thirty-six horse power in two minutes and a half. Generally speaking, the electric heating may be done in a tenth of the time required by the forge or furnace, and the power required is between three and four horse power per cubic inch of metal heated. The feature of electric heating already noticed of a bar becoming more highly heated at the center than at the surface when exposed freely to the air, is shown in a very convincing manner at this exhibit by fusing the core of an inch bar without it losing its shape. A consequence of this internal heating of a bar is the holding of its heat much longer than a forge-heated one, permitting of forging operations with one heat which would require two or three by the old method.

One of the most striking things in the exhibition—remarkable on account of being so entirely out of harmony with all our ideas

of the conditions under which we expect to see heat generated—is the apparatus to be seen in this exhibit which may be appropriately termed the "water-pail forge." This consists of an ordinary wooden pail filled with water into which dips a metal plate connected with one terminal of the electric circuit. The other terminal is attached to a pair of blacksmith's tongs, with which the operator picks up and holds the piece of metal to be heated. Immediately upon his plunging this into the water the liquid begins to sputter and the metal to glow, until in a few seconds it is brought to a welding heat and is then speedily melted. The heating is so rapid that neither the water nor the metal a few inches away are more than slightly warmed. This curious phenomenon appears to be due to the localization of the resistance of the circuit at the surface of the heated metal by the interposition of a layer of hydrogen between the metal and the liquid. This is the explanation offered by two Belgian engineers who recently brought out the process abroad with apparently no knowledge of its prior use in this country. In their apparatus they used a glass jar lined with lead which formed the positive pole. The water was acidulated to render it conducting. When the circuit is completed by the immersion of the metal to be heated the current decomposes the liquid, the oxygen going to the lead plate and the hydrogen to the iron or other immersed metal and preventing any direct contact of the metal and the liquid. As hydrogen is a very poor conductor of electricity, the resistance would then be localized at the surface of the metal plate, with the result of heat being rapidly developed at this point. An American investigator, Mr. Jules Neher, who has experimented with the process, regards the heating as being due to the formation of an arc between the heated metal and the liquid, as he has observed that the heating does not take place if the metal be immersed before the current is turned on, the energy of the current then being spent in the electrolysis of the liquid. His explanation is that immediately the metal touches the liquid hydrogen begins to be liberated and, interposing itself between the metal and the liquid, draws an arc in the act of pushing the two asunder. This arc formed under water quickly raises the metal to a high temperature. Whatever the precise explanation, it certainly is a most astonishing thing to see pieces of iron and steel glowing at a white heat and running away in melted globules while surrounded by water. The capabilities of the apparatus would appear to be almost unlimited, and it is not too much to say that it is destined to find wide application in the arts. The operator has at his command the practically unlimited energy of electricity, and should be able to reach temperatures with it heretofore unattainable. The Belgian experimenters are reported to have succeeded in fusing carbon, and it has been suggested that

it is within the range of possibility that we may in this way reach the solution of the problem of the artificial production of diamonds..

Another and very different use of the heating power of the electric current is its application to cooking and house heating. Attempts have been made for some years now to adapt the current to these purposes, and what has been accomplished in this

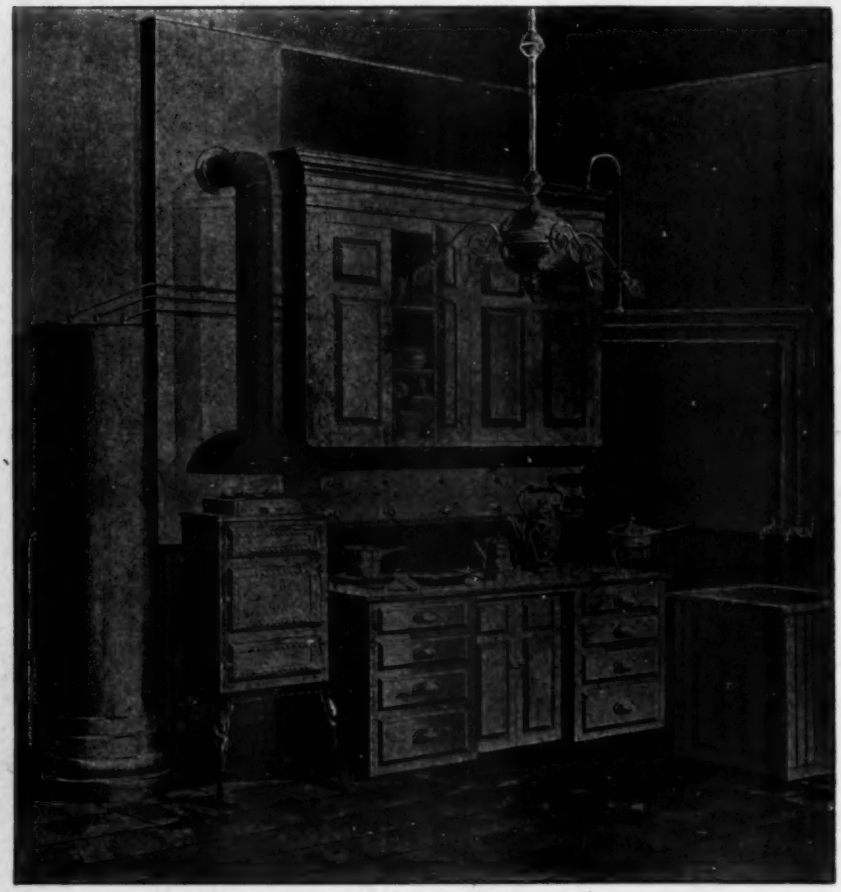


FIG. 10.—AN ELECTRIC KITCHEN.

direction is to be seen at the exposition. After considerable experimenting the final form which has been given to the apparatus for such use as hot plates, broilers, and water heaters is that of a wire imbedded in enamel such as is at present used upon kitchen utensils. The wire most commonly employed is German silver, though in some cases platinum has been used. In applying this construction to a flatiron, for instance, the base of

the iron is made in the form of a shallow tray into which the enamel is poured. The wire in the shape of a zigzag forms a flat coil completely surrounded by this insulating compound. A hot plate suitable for heating a kettle of water or baking griddle cakes is made in the same way, and a grid or frame with gutter-shaped bars filled in with the enamel serves as an oven heater, a sufficient number of these grids being disposed at various parts of the oven. Operations such as the broiling of steak are performed on a modified form of broiler in which the ordinary wires give place to narrow inverted U-shaped bars. The heating wires are carried through the hollow space of these bars and imbedded in enamel. For the heating of water in special vessels, such as the ordinary kitchen boiler, the vessel is made with a bottom in the form of a hot plate. In all the utensils shown at the exhibition the enamel used is of the ordinary gray variety which requires firing, but an enamel for this purpose has been introduced in England which needs no baking. When it comes to heating either by direct radiation or through the medium of hot air, the form finally adopted is that of a coil of wire wound over a pottery or porcelain center and partially inclosed in an iron case. For car warming, heaters are placed under the seats, and located so that they can radiate directly into the car, wire guards being placed in front of them to protect the clothing of passengers. Such heaters have been introduced quite extensively into trolley cars, and are said to have been found economical when everything is taken

FIG. 11.—ELECTRIC HOT PLATE.

into consideration. They require no attention, and take up no room which would otherwise be occupied by passengers, both items of economic advantage in such a use. Heaters designed to take the place of the hot-air furnace are constructed in the same general manner as those for car use. The plan is to place a large primary heater in the cold-air box of the ordinary furnace, and then subsidiary heaters just inside the grating of registers, by means of which additional heat may be obtained when the main heater is insufficient. All classes of apparatus are made to be used with either an alternating or continuous cur-

rent, and adapted to be attached directly to the ordinary electric supply circuits.

Ideal this method of cooking and heating certainly is, and ideal it is likely to remain. There are many things electricity can do—many things it is doing which were without the bounds of our expectation of even yesterday—but supplying heat in economic contrast with coal and gas for the ordinary operations of the household is not one of them. This is, of course, upon the condition that the current is generated by the combustion of fuel. In situations in which the current is produced by water power, and in which fuel is scarce and dear, the unit of heat furnished by electricity may very well bear comparison with that by direct combustion; but that you can not start with combustion, suffer the tremendous loss of the steam engine, the various losses of the electrical apparatus, pay a profit to the electric supply company, and still compete in point of economy with the primary process of combustion, would seem to be a proposition too clear to need demonstration. Looked at from the point of view of percentages, the steam engine makes a return of but ten per cent of the heat energy of the fuel, the dynamo can hardly be depended upon in practice for more than ninety per cent, and the converter, when this is used, may be counted to absorb ten per cent of the energy delivered to it. This leaves in the one case but nine per cent and in the other a little over eight per cent of the original energy at the disposal of the consumer. Some of this must inevitably be lost in the final heating operation, for, though the apparatus be designed never so well, it can not have an efficiency

FIG. 12.—ELECTRIC COIL HEATER.

of a hundred per cent. The consumer, therefore, can have in an available form not more than ten per cent and probably not over seven per cent of the heat in the fuel with which the cycle of operations started. This is an efficiency much below that obtainable from the direct combustion of the fuel by even the most wasteful methods, and at no price at which electrical energy can be furnished could the two forms of heating be brought on the plane of economic equality. A direct comparison of the actual number of heat units (pound-degree Fahr.) present in each instance will show with perhaps greater clearness the economic relations of the two methods of heating. A horse power of electrical energy is equivalent to 2,565 heat units per hour. A pound of coal contains 13,000 heat units, and costs, with coal at five dollars per ton of 2,000 pounds, a quarter of a cent. If we give to the coal an efficiency of but ten per cent, it will require two pounds to equal the available heating power of the electrical horse power, allowing that all the heat in the latter case is utilized. This will cost the user half a cent, and making due allowance for the collateral expenses of coal as a fuel, such as kindling, removal of ashes, and cost of handling, it is very evident that electricity can not hope to offer any economical competition. The commercial promoters of electrical heating count upon a charge to the consumer of five cents per horse power per hour for cooking purposes, and a cent and a half for heating purposes. This is very much under the figures at which electric power is now being furnished for lighting purposes—the charge for this being at the rate of from twelve to fifteen cents per horse power-hour—but it is proposed to make the same discrimination between light and heat that the gas companies have instituted. At the lower figure electric heating is nearly three times, and at the higher nearly ten times, as expensive as that by coal, allotting to coal the above very low duty. But coal has no such low efficiency. The radiant heat from hard coal is fully twenty-five per cent of the total heat generated, and of this fully one half is utilized in a grate fire, which is the most wasteful of the heating devices in use. In the best forms of grates which have been devised, in which the surplus heat is used to warm the air supply of the room, as much as thirty-five per cent of the heat may be made available, while in close stoves of the best patterns the efficiency will not fall below seventy per cent.

With gas the comparison is of course much more favorable, as here the cost of a unit of heat is much greater than in the case of coal. Illuminating gas has a heating value of six hundred and fifty to eight hundred heat units per foot, according to the quality of the gas. At the lower figures it requires a trifle under four feet to equal the heat value of an electrical horse power.

Gas may be counted upon for a duty of seventy-five per cent; so that the amount necessary to do the heating work of the electrical horse power will be five and a third feet. This, with gas at a dollar and a half per thousand will cost ·078 of a cent, and with gas at a dollar a thousand—a not uncommon price at present in the United States—will cost but little more than half a cent. For cooking purposes the two methods of heating are on an equality in the matter of ease of manipulation, absence of collateral expenses, and limitation of the use of the fuel to the exact time required to perform the operation in hand. Their value to the householder is, therefore, in direct ratio to their cost. Gas clearly has the advantage of being from five to ten times the cheaper source of heat, an advantage so great as to make its supremacy secure. With the cheaper forms of fuel gas which have grown up, and will doubtless come into larger and larger use as the lighting field of gas dwindles, electricity can have even less chance of competing. This method of heating will doubtless find a field of its own, in which its use will be determined by other conditions than those of economy, but it can never hope to take over to itself any considerable part of the heating domain, so long as fuel remains at anything like the present prices.

The Centennial left us in the telephone a new method of communication, which in the time since then has grown into one of the necessities of business life. The Columbian will leave us, in the telautograph of Prof. Elisha Gray, another method of communication which promises to rival the telephone in utility. This new method is not exclusive of the earlier one, but rather supplementary to it. The telephone has endowed us with the power of talking at a distance; the telautograph will confer upon us the ability to write in the same way. It supplies an essential feature lacking in the telephone—a record—and hence becomes available for many uses for which the telephone is unfitted. Mistakes so liable with speech transmission are here impossible, as the receiving instrument reproduces faithfully all the movements of the transmitting pencil, and only a blunder upon the part of the sending operator can cause misunderstanding or confusion. With telautograph exchanges established in cities after the manner of those of the telephone, it will be possible for subscribers to do by means of it much of the correspondence now carried on by mail; and when the system is extended to provide communication between cities, the business man will have at his disposal a method of letter transmission incomparably more swift than the most rapid of fast mails. The extent to which such a system may be used in substitution of mail service will, of course, depend upon the expense attending it, and as this must always be greatly in

excess of letter carriage, it can apply only in cases in which important interests are involved and dispatch is of moment. Such instances are, however, growing increasingly frequent in the modern business world, so that the telautograph, if it prove as successful in actual commercial work as it has in experimental tests, will not lack for a large and profitable field.

The attempts to realize facsimile transmission go back almost to the beginning of telegraphy. As early as 1846 Alexander Bain attempted such reproduction by means of trailing contacts passing over the face of metallic letters at the transmitting end of the circuit, and like contacts sweeping over a chemically prepared paper at the receiving end. When the contacts were on the faces of the letters a current was sent to line; and these current impulses, decomposing the chemical preparation of the receiving paper, made brown or blue marks, according to the nature of the chemical solution, which reproduced in broken outline the original letters. This method of operation was ten years later much improved by Caselli, who transcribed the message or sketch to be sent on a metallic-faced paper, and caused a stylus actuated by a pendulum to traverse in succession all parts of the design. A similar stylus reproduced the drawing or writing on chemically prepared paper at the receiving end. Many attempts have been made by subsequent inventors to adapt this method of transmission to commercial work, but without success. All systems of this kind, it will be observed, depend upon the establishment of exact synchronism between the transmitting and receiving instruments, and this is a condition very difficult to realize in practice. Moreover, the message must first be written either in a special ink or on a special paper, and afterward transmitted, which renders the process slow and necessitates expert knowledge to operate it.

The telautographic method proceeds upon entirely different lines. In this the movement of the transmitting pencil in the hand of the operator causes electrical impulses to be sent over the line, which impulses, through the medium of appropriate mechanism, act upon the receiving pen and cause it to duplicate the movement of the sending one. The possibility of doing this depends upon the geometric principle that the movement of a point in describing a plane curve, no matter how intricate, may be resolved into two rectilinear movements at right angles to each other. In order, therefore, to have the pen at the receiving end of the line follow all the motions of the transmitting one, it is only necessary to resolve the movement of this latter into its right line components and reproduce them at the further end. A point situated at the focus of these lines of movement will then describe the exact motions of the original one. Simple as this

conception is, it has been found by no means an easy one to realize in practice. The first one to attempt the application of this principle to autographic transmission appears to have been Mr. E. A. Cowper. In his apparatus, constructed in 1874, the receiving pen was mounted upon a light armature located between the poles of two electro-magnets placed at right angles to each other. These magnets were included in separate line circuits, and when energized by currents from the transmitting end of the line, attracted the pen armature, causing it to describe a line or curve which was at every instant the resultant of the two right-angled magnetic attractions.

These magnetic attractions were varied in exact accordance with the movements of the transmitting pen by augmenting and diminishing the strength of the current flowing through the magnet coils, and this variation of current strength was in turn accomplished by causing contacts attached to the transmitting pen to pass over the terminals of resistance coils and successively cut out or introduce resistance in the line circuits. On account of the very limited movements which could be given to both the transmitting and receiving pens, the writing had to be done upon a strip of paper which was moved under the pen. The writing with the transmitting pen was done through a square hole about an inch on a side, and the characters had therefore to be made practically one over the other. There was thus but little opportunity for the operator to follow the work and see clearly what he was doing, and only an expert could make an intelligible writing. The details of this method were subsequently much improved by two American inventors, and the apparatus employed for a time in commercial work; but the essential limitations of the method proved too serious a handicap, and the system soon fell into disuse.

FIG. 13.—TELAUTOGRAPH TRANSMITTER.

In taking the subject up experimentally Prof. Gray at first used the method of a variable resistance, but he speedily abandoned it as impracticable, and adopted the step-by-step method of operation, which he now uses. This consists in causing the transmitting pen to send to the line a succession of distinct electrical impulses, the number of which is governed by the extent of the pen's movement, which are employed, not in affecting the receiv-

ing pen directly, but in controlling the mechanism which actuates it. As the extent of movement of the pens is determined only by the number of electrical impulses, these may be given any desired range, and it becomes possible to use the transmitting pen with almost the same freedom as a pen or pencil in ordinary writing, and to write in the same way—that is, in successive lines extending across a page.

In the final form given to the instruments by Prof. Gray and shown at the exposition the transmitter consists of a box provided with a leaf upon which the paper rests. The paper is drawn continuously from a roll, and is shifted mechanically from time to time by the operator. The writing pen consists of a pencil lead mounted in a holder, to the lower end of which two silk threads are attached. These threads are at right angles to each other, and lead from the pencil to two drums, upon which they are wound in such a manner as to cause the drums to rotate backward and forward as the threads follow the movement of the pencil point. The drums, therefore, move in exact accordance with the rectilinear components of the pen's motion, and it is only necessary to reproduce their motions at the other end to cause the receiving pen to duplicate the movements of the transmitting one. In an earlier form of the transmitter each drum carried an arm, which was swept by its movement over a series of radial electrical contacts, and thus sent a succession of electrical impulses to line. The friction of this moving arm was, however, found to be objectionable, and this arrangement has therefore been replaced by a magnetic device in which a toothed iron disk acting magnetically upon a soft iron lever keeps this in vibration. This lever plays between two contact points, and according as it is upon one or the other of the contacts a positive or negative current impulse is sent by a battery through the line circuit. These current impulses of alternating polarity serve to operate at the receiver polarized relays, which control by means of escapements drums similar to those in the transmitter, which drums actuate the receiving pen.

FIG. 14.—TELAUTOGRAPH RECEIVER.

This pen consists of a glass tube drawn to a capillary bore at the end and supplied with a free-flowing ink from a reservoir by means of a rubber tube. It is mounted upon and at the junction

of two light aluminum arms, making a right angle with each other. Each of these arms is attached to its operating drum by means of a cord passing around the drum, so that the rotation of this moves the arm to and fro in the direction of its length after the manner of the ordinary bow drill. The drums are given a tendency to rotate by a small electric motor located in the case of the receiver, and as this rotation is controlled by the polarized relays, which are in turn operated by the current impulses sent out by the transmitting pen, it will be seen that the movement of this latter determines that of the receiving pen, both in amount and direction, and that hence the two pens must move in exact ac-

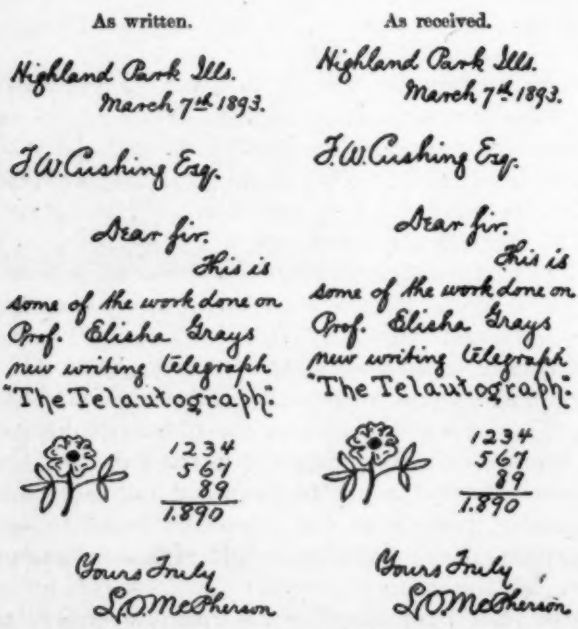


FIG. 15.—SAMPLE WORK OF TELAUTOGRAPH.

cordance with each other. The mechanism of the receiving instrument is at present a little intricate, and some of the operations to be performed, as the lifting the pen from the paper, shifting the paper, and reversing the motion of the operating drums, require in the present construction two additional line wires, but these, it is expected, can by contemplated improvements be dispensed with, leaving only two line wires for the performance of all the necessary operations. The system has so far been operated over a distance of only thirteen miles; but from the character of the currents used—distinct successive electric impulses—there would seem to be no reason why it should not be capable of operation over as long distances as the ordinary telegraphic instruments.

THE PESTALOZZIAN SYSTEM.

By Hon. GEORGE S. BOUTWELL.

IN the May number of The Popular Science Monthly is an article by Prof. W. W. Aber, entitled The Oswego State Normal School, in which the writer claims for that institution the credit of introducing and promulgating over the country the system of teaching known as the Pestalozzian system.

Upon the statement made the Oswego School was founded in 1853, but upon ideas far away from the system of Pestalozzi, and it was not until 1859 that "lessons on form, color, size, weight, animals, plants, the human body, and moral instruction were prominent."

As to moral instruction it may be said that there was never a time when it was not prominent in the schools of Massachusetts, with object lessons drawn from passing events. In 1859 or even in 1853 nothing could have been gained in Massachusetts from the system of Pestalozzi as to the wisdom or the method of teaching morals in the public schools.

Physiology had been taught in the normal schools of the State and by the aid of the manikin for nearly two decades. It had been introduced and urged by Horace Mann, who disappeared from the Massachusetts schools about the year 1842.

In the year 1859 there were four State normal schools in Massachusetts, three of which had been in existence for about twenty years, and the junior was established in the year 1854.

In all these schools the art of teaching was taught according to the system of Pestalozzi and by well-informed teachers and professors, and with the knowledge that it was the system of Pestalozzi.

In the year 1856 Prof. Hermann Krüsi, who is credited in the article with aiding in the introduction of the system at Oswego, was employed by me in the Teachers' Institutes and Normal Schools, and he continued in that service for about three months in each year until 1860, inclusive. Of the other teachers and professors who were employed in the Teachers' Institutes and Normal Schools in the fifties I may mention President Felton, of Harvard College, Agassiz, Guyot, Alpheus R. Crosby, George B. Emerson, Lowell Mason, and William Russell, all of whom gave lectures and illustrated the art of teaching on the system of Pestalozzi.

I recall examples of the art of teaching grammar, through the aid of an object, given by Mr. Emerson, and I can not imagine that he has been surpassed to this day.

Previous to the year 1859 the art of teaching according to the

system of Pestalozzi had been taught and the practice of the art had been illustrated to thousands of students in the Normal Schools and teachers in the Teachers' Institutes in the State of Massachusetts.

Of the system of Pestalozzi everything was then known that is now known, although the application of the system may have been improved in these thirty years.

Much credit is due to Dr. Sheldon, the founder of the Oswego School, but it is manifest that in 1859 he was ignorant of the educational condition of the country, and consequently he sent across the Atlantic for information which he could have obtained in New England.

As to the system of Pestalozzi there was nothing new but the system. The mode of teaching had been exhibited occasionally and unsystematically through many long years. In my boyhood, in the thirties, the scholars in a country village school were trained in the science of astronomy by outdoor lessons in clear evenings and with the aid of a celestial globe. In Morse's Geography, published in the last century and prepared by the father of the inventor of the telegraph, physical geography is made the primary fact of the study, thus anticipating Guyot, whose system was based on the teachings of Pestalozzi.

The opening questions of Colburn's Mental Arithmetic, "How many thumbs have you on your right hand? How many on your left hand? How many on both hands together?" contain and express the rudimental truths of the Pestalozzian system.

In one particular Pestalozzi stands with Bacon: Pestalozzi did not discover a new method of teaching, Bacon did not discover a new method of reasoning. Each systematized a desultory but long-existing practice.

GREAT hopes are entertained by manufacturers from M. Chardonnet's method of making silk from wood-pulp, which has been set in operation at Besançon, France. The pulp, having been carefully dried, is treated for transformation into collodion, similar to that which is used in photography. This collodion, which is sticky and viscous, is inclosed in a stiff receptacle, furnished with a filter in the lower end. An air-pump sends compressed air into the receptacle, by the pressure of which the collodion is passed through the filter into a horizontal tube furnished with three hundred cocks, the spouts of which are made of glass and pierced with a small hole of the diameter of the thread of a cocoon as it is spun by the silkworm. The collodion issues through these holes, when the cocks are opened, in threads of extreme delicacy, of which it takes six to make one of the consistence required in weaving. This thread is hardened, previous to winding, by water, which takes up the ether and alcohol of the collodion, when it becomes as resisting and brilliant as ordinary silk. It is made slow of combustion by treating with ammonia.

THE SCIENTIFIC METHOD WITH CHILDREN.

By HENRY LINCOLN CLAPP.

AT a recent meeting of prominent educators in Boston to consider means of promoting work in elementary science, a well-known professor of science said that there was danger that college professors would make out a scheme for teaching science and impose it upon the elementary schools; that the work was likely to be begun at the wrong end.

This led another member to say that not a little danger was to be apprehended from the scientists themselves, because many of them taught as if the scientific method demanded that they should begin with the ultimate, undecomposable constituents of things. There was danger that they would hold to their own conceptions of elements and ignore the child's elements. There was a difference of opinion among their pupils, who became teachers, as to what elementary science meant. Not a few held that science was classified knowledge and but little else, and that no lesson could be a science lesson unless the objects studied were selected in a natural sequence. He added that children are midway between profundities and sublimities, that they know no more about nitrogen than about ether in stellar space, and that they should neither be dragged down nor up to satisfy the demands of some one's so-called scientific method. They have their own starting points, and those should be taken by the teacher.

To this the professor heartily agreed, as did all the others who openly expressed an opinion. Likewise, many other teachers of science readily agree with the points named, when they simply talk about them, but practically deny them in their teaching, for a considerable time at least. It is noticeable that the systematic plans, which they put on paper easily enough at the outset, undergo much modification in course of time as they work with large classes of children. In some unaccountable way the laboratory methods with which they are acquainted prove disappointing when tried with children.

The method of beginning to teach science with ultimate undecomposable elements, and "building up" step by step, with complete sequences and fine inferences, exhibits one phase of science work, especially that done in scientific schools by adult students. In the case of many teachers it seems to furnish all the fascinations and advantages of a thoroughly logical method, and to be in perfect consonance with the educational principle, "From the known to the unknown"; but there seems to be some unreasonable bias or ignorance of facts in the interpretation of the principle as applicable to children. This interpretation is apparently

based on the assumption that the known is simple rather than complex, is in parts rather than in wholes, and that the child's knowledge must of necessity be built up constructively or synthetically. There is some truth in this interpretation, but, followed out with children as far as we too often see it, it involves difficulties and errors of considerable magnitude. In this case, as in others, excessive generalization is dangerous.

Children's natural sequences are from wholes to parts, from the complex to the simple, from the superficial to what lies underneath, from the indefinitely known to the more definitely known, and the mental processes involved are analytical, especially in the early part of their school days. In this case, also, excessive generalization is dangerous. Undoubtedly, children acquire some knowledge synthetically, and as they approach adult life their powers of analysis and synthesis are increased by more frequent use, and no system or method that is excessive in either direction can be rightfully called scientific.

There is a time appropriate for working toward the profound and the sublime, but the start is fraught with danger. No method of teaching whose beginning is not definitely known can be called thoroughly scientific. So far as it fails to interest children, to make them use their own senses in the best manner, to make them think best in their own way, and to develop them best by means of their own activities, so far it fails to be scientific. If it succeeds only by reason of the teacher's great knowledge of the materials to be studied in a special line of work, or his "magnetism" or holding power, rather than by reason of the natural attractiveness of the things studied and the unobtrusive but skillful directive power of the teacher, it is unscientific. If it does not start independent motive powers, it is unscientific. The magnet seems to infuse life into iron filings, when placed near them, but when it is withdrawn they lie inert. Agassiz's method, as carried out by him, started many independent motive powers which are now vigorously at work throughout our land.

Among educational experts there is a difference of opinion as to where the best starting point is in teaching children elementary science. Dr. Mary P. Jacobi would use the flower in beginning to teach children botany, because it is the most attractive, makes the largest impression upon the senses, is easy of apprehension, and leads to the appreciation of specific differences. These are valid reasons, and might consistently be held by all who believe in that natural mode of working which embodies what the child likes, as clearly indicated by the history of the race, and what will develop his faculties in the happiest and most effective manner, such a mode as gave us Agassiz and Darwin.

Miss Youmans would begin with the leaf, on the assumption that it is simpler than the flower, and in tracing its scientific relations deeper intellectual pleasure is received.

The evolution of leaves into flowers is at the same time profound and sublime, outside of children's experiences and beyond their range of thought. Its teaching at the beginning results in cramming, however perfectly it may satisfy the demands of a philosophical but artificial system. Moreover, beginning with roots, as so many systematic teachers have done, and following with stem, leaves, flowers, and ending with fruits as the ultimate work of the plant, although logical to adults, full of regular sequences, and scientific from one standpoint, is unscientific from another. Children do not start to work with plants in that way, unless they are obliged to, but in a way diametrically opposite—attractive flowers and fruits first and unattractive roots last. It is certainly natural, although it may be heathenish and show their natural depravity for them to do so, but to scientific reformers they furnish an extensive field for missionary work in improving on the imperfect works of the Creator.

The uncertainty of where to begin and what to do in elementary science work during the last decade has resulted in much experimentation on the part of superintendents of schools, who are gradually feeling their way down to where the children are. They have entered on the work with unbiased minds, and, while laying no claims to scientific methods in conducting it, have thrown upon the subject valuable side-lights, which, if summarized and classified at a later day, will demonstrate what the scientific method with children must have for a basis.

In this work the scientific schools have played a very unimportant part. They are sending out graduates who do not know the principles of education, who have had but little if any experience with children in the schoolroom. Their efforts for a considerable time are nugatory, to say the least, if not mischievous, and tend to bring science work into disrepute and to make it seem impossible to any but specialists. Not only do they grope around when they attempt to teach the large classes inevitable in a city school, but the professors themselves have but little if any advantage when they "take hold." The methods and results of work in scientific schools are wholly admirable in the fields which such schools have thoroughly and honorably won; but as yet their methods have not been made suitable for different fields lower down. The methods of cultivating the hill country are in many respects unsuitable for the lowlands. The child's way of working is, or should be, different from the adult's. Many instructive illustrations of questionable methods may be given and added to indefinitely.

Not long ago one of the distinguished botanists of this country put into the hands of his pupils a sixteen-page syllabus containing full outlines of lectures on the seed—origin, structure, and uses; the stem and root; the leaf—structure and function; the flower—form and use; the fruit—kinds and functions; ferns, mosses, algæ, and fungi. The whole was covered in six lectures, and the published account bore the title Beginnings in Botany. If the scientific method, or any other, will insure such a work being well done, starting with no knowledge of the subject on the student's part, it has much to commend it to the attention of teachers of science.

Another scientist, who claims to teach by the "natural method," advocates a course of study on animals in the primary schools, which includes the study of the following subjects to be taken up in the order given: starfish, sea urchin, and the same compared; the earthworm; a bivalve shell, clam shell, oyster shell, and the same compared; snail and snail shell; classification of shells; lobster, crab, and the same compared; habits of crabs; and an excellent line of insects.

The attempt here made to select subjects in a natural (?) sequence is attended with some drawbacks. Away from the seacoast all of the material named, except insects, would have to be brought from a greater or less distance, and, being out of the range of the children's common field of observation, would necessitate more or less cramming. Things seen only in the schoolroom do not make the deepest impressions. An extensive use of imported material is directly opposed to Agassiz's injunction to use the material nearest at hand.

Moreover, it is worth while to remember that materials and methods which are serviceable enough in teaching adults often become forced and mechanical in teaching children. It should not be taken for granted that the teacher's sequences, laboriously studied out or taken from some book, are the pupil's sequences, or that he can assimilate them. Prof. McMillan, of the University of Minnesota, says: "No mistake could be greater than to suppose that the sequence most logical for the trained intellect is necessarily the best method of presentation to the novice. In our zeal to eliminate evils of systematic botany we are prone to introduce evils of anatomical botany no less great and equally to be avoided." So in our efforts to prevent pupils from being overwhelmed with information "away over their heads" and almost entirely the product of the adult mind, we have taken on the shackles of a rigid system or scientific method, also the product of the adult mind for the adult mind, and between the two methods the children have generally come to the ground.

One of the best illustrations of the uncertainty that exists as

to the best materials and methods to be used in teaching elementary science may be found in the public schools of Boston. About a dozen years ago a course in science for elementary schools was formulated and an attempt made to carry it out. The systematic study of animals was begun in the lowest grammar grade, fourth year in the elementary course, and the specimens to be studied in order were thus laid down: "Sponge and coral compared; starfish and sea urchin (dried specimens) examined and compared; oyster, clam, and snail compared; shells of different forms compared." The lessons that preceded the study of the objects named were information lessons on "grass-eaters, flesh-eaters; animals with hoofs, claws, wings; land animals, water animals, etc." Systematic mineralogy, without any previous work on minerals, was begun in the sixth grade on these mineral substances: "(1) metals that are native minerals (gold, silver, copper); (2) metals from ores (lead, zinc, tin, iron); (3) non-metals (sulphur, carbon); (4) gases (oxygen, hydrogen); compounds: iron rust, carbonic-acid gas."

This course, of which parts have been given as illustrations, was the best product of one of the leading spirits in science work, aided by the advice of teachers of science in the scientific schools of that time. It is questionable whether the scientific schools of to-day can formulate a better course for children. The method employed to carry out the course satisfied the demands of those who were regarded as experts in science work as to elements, natural sequences, synthesis, and system; but although the work was pushed vigorously in the beginning, it soon began to stick, and finally failed altogether. Of course, scientists called the work scientific, and teachers who were simply literary thought it discreet not to question that decision; but it is evident now that a very important scientific element was lacking—namely, the science of success, knowing how to succeed; and that lack resulted from a failure to recognize the child's standpoint.

It is claimed by teachers of science now that the reason why such a course in natural science can not be carried out successfully is the lack of specialists to teach in every class the particular subjects named by the method used in the scientific schools. Doubtless an adequate supply of specialists would suffice to force the study to an apparently successful result; but the necessity for the application of so much force to a study that has the term "natural" so frequently applied to it should make us pause and consider whether the resistance to be overcome is not caused by some artificiality into which we have unconsciously drifted. *Natural* education is unconsciously easy, and difficulties increase as it becomes artificial. "The lines of least resistance" should not be overlooked in any educational plan.

The former course in science in the Boston schools having failed, a somewhat radical change of base in such work has recently been made. In the first place, the term "elementary science" is not approved by many teachers who adhere to the dictionary meaning of the term. They say that no real science work can be done in elementary schools, and will not admit that elementary science means *simple knowing*, when used to designate children's acquisitions of knowledge at first hand, but insist on limiting the term to the scientist's elements and organized knowledge. They give an unscientific excuse for failing to teach science in a natural and successful manner. On the whole, "observation lessons" is an acceptable term to use in designating children's work with natural objects. If a mere name be made a stumbling block, it had better be changed at once.

Now, the course in the Boston schools requires "observation lessons" on the "structure and habits of familiar and typical articulates and vertebrates," including the frog, fish, robin, hawk, hen, duck, cat, dog, pig, rabbit, horse, and cow, in the fifth grade. In the sixth grade the work is continued by observation lessons on "typical and familiar specimens of radiates and mollusks (sponge, coral, starfish, oyster, snail, jellyfish)," and ends with observation (?) lessons on the elephant, whale, seal, cochineal, and ostrich.

The study of minerals is begun in the sixth grade, as before, but the materials used are common rocks, instead of native minerals and chemical elements, which are studied in the ninth grade.

In this radical change from the former course there is an evident intention to depart from the so-called scientific standpoint and approach the child's point of departure; but those inevitable errors have been made that always attend the laying out of courses on paper before working them out carefully with many large classes of children.

It is manifest that there can be no proper observation lessons —not to mention what commonly pass for science lessons—on the whale, the seal, the ostrich, etc., in an ordinary city grammar school. The same may be said of the frog, the hawk, the pig, the cow, etc. Such things can not be brought into the schoolroom with compensating advantages. If pictures are made a substitute, the work with them deserves no better designation than information lessons, and speedily degenerates into first-class cramming.

Concessions to the scientists may be seen in the requirements in regard to the structure and classification of articulates and vertebrates in the fifth grade, typical radiates and mollusks in the sixth grade, and the order of studying minerals in the ninth grade, beginning with elements and working up synthetically to com-

pounds. Such study is unquestionably better adapted to the ninth grade than to the sixth or lower grades. The classification of radiates, articulates, and vertebrates has never had marked success in high schools, and nothing worth mentioning has been done in that line in grammar schools.

After all that has been done in formulating courses in elementary science on paper in Boston, not to mention other places, the work has never been in a more unsatisfactory condition than now, since the first course was introduced into the schools a dozen years ago. What has been called the scientific method has failed in the elementary schools, if not in the high schools; and now another overturn of the course in science work is taking place in Boston.

How far the traditions and methods of the scientific schools are responsible for the delay in reaching the child's point of departure for things scientific can not be set down with exactness; but their isolation and conservatism certainly have not furnished them with such conditions as could be turned to the advantage of children just starting out into school life.

In writing, we no longer adhere to pothooks and trammels; learning the alphabet and spelling *a-b abs* are not our best means of teaching reading; mere ciphering with abstract figures in arithmetic has been superseded by more rational processes; committing to memory paradigms and grammatical rules has failed to enable students to use language fluently and correctly; nevertheless, all those things were formerly considered essential elements, and the only proper starting points for scientific teaching in the lines of work indicated. So the starting points of the scientific schools must be discarded for more natural and appropriate ones in the elementary schools. We shall use the children's elements, and discover upon what they work with interest and independence, how they work, what will best call out their activities and enable them to teach themselves, and by what means they can express their ideas best. The basis of instruction in elementary science must be the child's natural method of working upon his own elements, the things that are simple to him. His elements of expression in language are *words*, not the elements of words; in drawing *outlines*, not points and straight and curved lines; in science, *what he knows at first hand* through the medium of his own senses—*superficies, externals*, not internals, anatomy, and remote elements. A lack of knowledge of this side of science work will make all other sides ineffectual.

The science of teaching demands full recognition of an adequate *presentation* of the subject to be taught. The normal schools rightly claim that good *reproduction* naturally follows good presentation; but unfortunately they too often assume that

the teacher must make the presentation. The consequence is, that all the points of a subject are set forth as clearly as possible by the teacher, and a summary closes the first stage of the instruction. Teachers often acquire excellent reputations by thus illustrating their skill in developing a subject logically and bracketing out the syllabus of the work, as some one has said, "on a rod of blackboard." Then comes the reproduction or presentation by the pupil, and, if he does not reproduce the instruction well, the subject is thought not to have been presented clearly enough, and often the presentation is repeated. This method is said to be psychological and scientific; nevertheless, it induces passivity, a habit of waiting to be told what to do, and a wrong attitude for the work of investigation. It is distinctively a literary method that is carried over into science work with disastrous results.

The best presentation of a thing is made by the thing itself, which must be suitable for the grade in which it is used, being simple in form, color, and parts for low grades—not necessarily of simple and regular form, nor of one color, nor of two parts. "The presumption of brains" must apply to the youngest pupils of school age. Experience shows that pupils who are permitted to draw and describe in writing simple, natural objects, guided only by a very few words written on the blackboard, acquire such a habit of application and power of expression as can be developed in no other way as well or as soon. They are so pleased with the expression of their own ideas, when they have been well started, that the disposition to appropriate other persons' ideas to save themselves from thinking or to copy the expression of them is counteracted. Their most imperative needs are *opportunities to work by themselves, skillful guidance, and generous encouragement.*

The question-and-answer method is the principal method of instruction in both the normal schools and the scientific schools. It appears to be the most scientific method generally known, and accordingly is *the* method used in teaching science. The teacher, in giving a lesson on a natural object, prepares her questions carefully in a systematic order, anticipates the probable answers of the pupils, and determines the exact answers which they must give at last. To do this heavy work a multitude of "leading questions" is necessary, and to ask and answer the questions consumes much time and calls for exhausting labor on the part of the teacher. The questions are put in order with considerable difficulty, which varies with the amount of freedom permitted, and the pupils are said to be led to investigate for themselves. The answers of the brightest pupils are frequently written on the blackboard, where the dullest pupils may read them and try afterward to pass them off as their own. The process insures con-

siderable uniformity but is very deceptive. A small proportion of the pupils most responsive try to answer as they think the teacher wishes, and a large proportion wait to hear what the others say and try to remember that. The questions are in a way answered by observations of the specimens in hand, but the "leading" process is so powerful that practically it amounts to indirect telling. Information much disguised is the staple material of the lesson, although it is not intended, and the giving of it is simply transferred from the teacher to a few responsive pupils. As a whole the pupils do not "take hold," and the disposition to make independent investigations is not cultivated.

A principal of a training school on hearing such a lesson comments thus: "This brought us to the end of a *very logical lesson*, but one which was at the same time one of the most mechanical, most wooden, most stupid and profitless lessons to which I ever listened. It was all right according to the letter of the law, but where was the spirit of education? I need not tell you of the unrest, the inattention, the new channels of activity that the children opened up for themselves, the imitation, the lack of spontaneity, the utter inability to hold the mind to this dreary treadmill."

Isolation tends to exaggerate variation. The normal school has not been connected with the scientific school, and neither has been closely connected with the elementary schools. Only within a very few years have city normal pupils had somewhat regular practice in teaching in elementary schools; and even now the practice must be very limited in city schools, since the latter must do regular and efficient work and not be interfered with much by novices in teaching. Pupils of the scientific schools have not had the meager opportunities for teaching which have been furnished normal pupils. If they attempt to teach science in elementary schools, they are obliged to experiment with children, not only to find out what the children are prepared to do, but what they themselves can and can not do; and their experiences, as well as those of their pupils, are full of surprises and disappointments. Some graduates of scientific schools take charge of the science work in normal schools, whose special work is to instruct teachers in natural methods. It is fair to ask whether such graduates, who have the opportunity of influencing so many teachers, are helping or hindering the cause of elementary science. Neither the normal schools nor the scientific schools, although they differ widely in methods and seldom touch common ground, consider the possibility of graduating pupils who are more than likely to prove unscientific teachers of elementary science.

The correlation of the normal school, the scientific school, and the elementary school, practically carried out, would give us a

fair prospect of discovering the true scientific method in teaching children.

I have seen an elementary school of some six hundred pupils, in which teachers and pupils follow closely the scientific spirit, if not the very letter, so far as it should be followed by children varying from five to fifteen years of age. All do the same kind of work, which is allowed to vary in quantity and quality in accordance with the natural ability, individuality, and originality of each pupil. Local material almost exclusively is examined individually, each pupil thinking and passing judgment for himself, and expressing his ideas accordingly in writing and drawing. The disposition to attack, to take hold, to investigate, and to make careful records of his own ideas and discoveries is cultivated studiously by keeping the pupil in the foreground and the teacher in the background. The prominent instructor, questioner, talker, gives place to the quiet director, inconspicuous but working with the effectiveness that characterizes the silent forces of Nature. The work is entirely independent of the normal school and the scientific school, but it is suitable, plastic, and power-giving.

A brief mention of some of the materials used in the work and a description of how they are used may serve to show whether the work is worth doing.

Each pupil is supplied with a specimen (all the specimens being of the same kind), such as can be found in the neighborhood —a leaf, a vegetable root, a nut, an insect, a rock, a flower, etc.— which he examines carefully, draws, and describes in writing, according to a very simple plan consisting of four or five words written on the blackboard. The words indicate the order of the work and the paragraphs of the description. The pupil is let entirely alone until he has done all he can do.

To draw his specimen he looks at it one way and gets one good presentation and impression; to describe it he examines it in a different way and gets another good presentation and impression —a process that holds him to his work without his being told what to look at, what to draw, and what to describe. He helps himself, and soon forms and fixes the habits of application and self-reliance. His work shows his teacher exactly where he is in drawing and descriptive work. Constantly judging of proportions, especially those of irregular objects, he soon learns to grasp the proportions of various forms quickly and to represent them with such facility and accuracy as to surprise teachers who have carried out only the regulation course in drawing. Many pupils can draw natural objects much more satisfactorily than they can describe them in words, and that, too, without formal instruction.

The ordinary courses of instruction in drawing, treating almost exclusively of artificial and symmetrical forms, have not

helped children to draw the natural objects which they study to any great extent, but often have hindered them by taking all their drawing time for dogmatic instruction in mechanical drawing, historic ornament, geometric solids, and regular, symmetrical objects generally. No instruction in natural history work can be called scientific that fails to develop the pupil's power to draw what he examines. Darwin said that a great amount of his otherwise valuable manuscripts became useless on account of his lack of ability to draw.

The part that language takes in the plan should now receive brief consideration. The pupil, being accustomed, from the time he begins to write sentences, to describe in writing what he himself sees, recognizes the connection between his ideas and their signs on paper; his facility in expressing his ideas more and more correctly increases; and when his work is criticised, he is in the proper mental attitude to receive and assimilate the criticism. By examining the pupil's work after his first essay on a new subject the teacher gets at the defects in the pupil's vocabulary at once, and sees just where to help him. In no other way can the teacher reach that point so soon. Since the pupil is left to himself, he must describe his object in his own words, and he will not use any that he does not understand; if those are wrong in form, he can remember the corrected form easily; but if new words, which he does not understand, are given to him, he remembers their correct form with difficulty.

The teacher helps at the right time when the pupils need help. He examines their papers to discover excellences and errors in regard to matters of fact and forms of expression, gives class instruction at the blackboard on the prevailing errors, makes illustrative sketches, rubs out all illustrative work at last, and directs the pupils to redraw and redescribe the objects previously studied, confining their work closely to what they see in their specimens.

Up to this point all information not obvious in the specimens is rigorously excluded. Information must be divorced from observation. No other course can be followed safely by the rank and file of teachers. The pupils, having had the opportunities required for observing, thinking, and recording for themselves, and a substantial basis for information having been thus laid, individual experiences, readings from books, and reasons, causes, and results are considered, and the whole, observation and information, is incorporated into a composition most carefully written during the time devoted to language work. The power thus developed in the lower grades enables pupils of the higher grades to stop with first drafts.

Again, Darwin confesses that he was much hampered by his

lack of facility in expressing his ideas. In his youth he had no training worth naming in drawing or in written description. To know and not to know how to express what is known is questionable science. The true scientific method must include adequate expression.

As a rule, such objects are selected for study as will serve for a good drawing (thirty-six rocks and minerals excepted)—shells, crystals, leaves, seeds, seed-vessels, flowers, ferns, mosses, and insects—including butterflies, moths, crickets, grasshoppers, locusts, flies, dragon flies, beetles, bees, wasps, and hornets—each kind being sufficient in number to supply each pupil with a specimen. Butterflies emerge from chrysalids and moths from cocoons discovered and brought in by the pupils, who draw and describe the various stages of these insect metamorphoses as they see them going on. They have studied in the same way seedlings in successive stages of growth—corn, squash, maple, acorn, etc.—each pupil having his own marked pot.

The school garden contains much available material—many varieties of wild asters and golden-rods, spring flowers, fall flowers, wild and cultivated, vegetable roots, small patches of wheat, rye, oats, barley, and buckwheat, cucurbitaceous plants, corms, tubers, bulbs, and ferns. The pupils cultivate the plants, and compare, draw, and describe the varieties from notes taken on the ground.

Once a year, on "public day" in May, the pupils bring in for exhibition their collections of minerals, rocks, shells, woods, insects, and pressed plants—usually from five to six thousand specimens which change from year to year. All the specimens are labeled carefully, classified, and arranged in the large hall on long tables covered with white paper. The best collections have a printed card label accompanying each specimen.

The work done outside of school in getting these collections together is of great educational value and the natural result of a method suited to the child's condition. It runs neither into haphazard channels nor into cast-iron molds. The child, rather than the subject matter, is the focusing point. The principal things sought are the science of his interests and habits of work, and the development of his powers of observation, expression, and self-reliance.

Many schools in various parts of our country are doing similar work, and in the summaries of such work made accessible to educators we shall soonest discover a scientific method thoroughly suited to the needs of elementary schools. Colleges and scientific schools have not the points of vantage to make the discovery.

NATURE AT SEA.

By FRANCIS H. HERRICK,
PROFESSOR OF BIOLOGY IN ADELBERT COLLEGE.

IN crossing the seas, as in walking through the fields, there is always the anticipation of making some new discovery. To-day Nature may reveal to us some long-withheld secret. This illusive bird or wild flower which we hitherto missed we now meet face to face. So it is in traversing the great blue fields of the ocean. On this voyage hardly a living object may be seen. The sea-serpent lies low. The captain complains of meeting few sail. Again, on the same track, the winds are fair, the ship makes her course, and the storm cloud no longer baffles the navigator. The inhabitants of the sea show themselves at the surface, and the long days lose their monotony. The voyage is a memorable one in the sailor's calendar.

A good traveler and genuine lover of Nature has the advantage often of turning the rubbish heaps of another to the best account. He finds gold where his companion sees only sand. We can hardly imagine Agassiz or Thoreau (the one representing the scientific, the other the poetic naturalist) at a loss to turn Nature to account anywhere under the sun. Thoreau delves in his Concord meadow and brings up some precious nugget, while Agassiz studies the waterworn pebbles and finds them more interesting than arrowheads. Yet our good observer is, no doubt, put to a severe test at sea, where he may often have occasion to repeat with feeling those familiar lines:

> "Day after day, day after day,
> We stuck, nor breath nor motion;
> As idle as a painted ship
> Upon a painted ocean."

I left Nassau, New Providence, the 1st of July, on a sailing vessel bound for New York. Our boat was a trim schooner of a hundred and fifty tons burden, clean and well ordered, and did credit to this kind of craft. We sailed out of the harbor and crossed the coral bar at high water under a steady southwest breeze which soon drove us out of sight of land and wafted us many miles away in the night.

The Bahaman capital shows to best advantage from the water. Its peak-roofed, chimneyless houses and stuccoed walls of coral stone make a strong contrast with their deep green setting of tropical foliage, the ever-encroaching bush which comes up to the threshold of the town on all sides, and covers these rocky islands with a perpetual mantle of vivid green. The impenetrable maze

of the fig and silk-cotton trees, and the looser, stiffer foliage of the almond, add here and there a bolder touch to the landscape, and the unmistakable cocoa palms, seen from afar, adorn the hillside or wave their feathered crests above the beach.

The town skirts the shore for some distance, covering the slope of a low ridge which lies parallel with it. From the brow of the hill an old fort looks down upon the clustering roofs below, upon the white streets, and the dazzling bluish-emerald waters of the bay. A remote fortress half hidden by mantling shrubbery stands guard on a low bluff to the right, while cottages and fishermen's huts, following the main street eastward, dot the shore for several miles on the opposite side. This picturesque little harbor has a livelier appearance to-day than usual. Dingy sponging boats and leaky-looking fishing craft lie along the wharf and down the bay, or are beached at low tide. There are larger vessels bringing ice from Maine, and the iron-gray sides of an English steamer loom

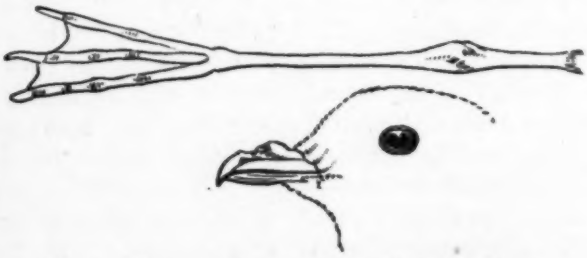


FIG. 1.—HEAD AND FOOT OF WILSON'S STORMY PETREL.

up from yonder low dock, where it now discharges its merchandise fresh from over the sea.

Sailing northeastward, Nassau and its shipping are soon obscured by the long green bar of Hog Island. This is in turn overlapped by similar keys, which gradually fade to green lines and dip under the waves.

For several days the ship speeds on with every sail set. Day and night not a sound is heard but the rustle of waves and the occasional flapping of a sail or sharp report of a rope on the taut canvas. On the sixth day out the sea was nearly calm, like glass, heaving in long, subdued billows, or like a silvered mirror, with slow, undulating tremors spreading far out to the horizon edge.

We noticed that the petrels now rested for the first time on the water after their long journey by wing. These little waifs appear never to alight except in calm weather. Day after day they follow the vessel in search of the stray scraps of greasy food thrown overboard. Now they flit noiselessly alongside, then dash on ahead or fall back astern, and so over the same course again hour

after hour for days at a time, without uttering a note or showing the least sign of fatigue.

Dauntless, brave-hearted little bird!—bred in the storm and passing thy life on the ocean wastes. How nimbly you trip along the surging waves, now hid in their deep valleys, or skimming their crests, which you pat with your slender webbed feet, as if to caress them when ready to ingulf you!

Fig. 2.—Portuguese Man-of-war.

We had not been at sea long before these petrels found us out, and they followed us hundreds of miles. At night I heard, or thought I heard, low, crooning notes from them, but was not sure this mournful sound did not come from some part of the ship's rigging. This is Wilson's petrel (*Oceanites oceanicus*), named in honor of that great lover of the birds, and well described by him in his American Ornithology. Wilson had an opportunity to study this species while coming by sailing vessel from New Orleans to New York. In order to examine them more particularly he shot a number, notwithstanding the superstitions of the sailors, who lowered a boat and helped him pick them up. These genii of the storm remind you of the swallow, whose graceful movement and power of wing they have, but, unlike the latter, they never soar above the turmoil of the sea. Their plumage is of a nearly uniform sooty-brown hue, excepting the tail coverts, or feathers at the base of the tail, which are snow-white. The physiognomy of the bird is marked by the beak, which points downward, thus enabling it to pick up objects with greater ease from the surface of the water. These delicate, soft-plumaged creatures are the scavengers of the sea. Toss out a few scraps of food, and the object of their comradeship is at once seen. Immediately their quick sense detects it, and all from far and near collect about the floating object, making a little dark cluster on the water. In thus taking their food they never alight, but hover over it, standing tiptoe on the wave or lifting their delicate black feet up and down as if dancing on the water. From this characteristic performance the name *petrel* is said to be derived from Saint Peter, in allusion to the story of his walking on the sea.

This and the rarer stormy petrel and a third species, which all resemble one another very closely, are commonly known to sailors as "Mother Carey's chickens," a name quite generally applied to this family, and probably suggested, as Wilson observes, by their mysterious appearance before and during storms, their great power of flight, and obscure habits. The superstitious mariner may indeed have regarded his little comrades not as harbingers merely, but as agents in league with the powers of darkness, directly concerned in bringing the storm. Mother Carey is the *mater cara;* so with the French these birds are "*oiseaux de Notre Dame.*" The gigantic fulmar of the Pacific is known as "Mother Carey's goose," and hence the phrase "Mother Carey is plucking her goose"—that is, "it is snowing."

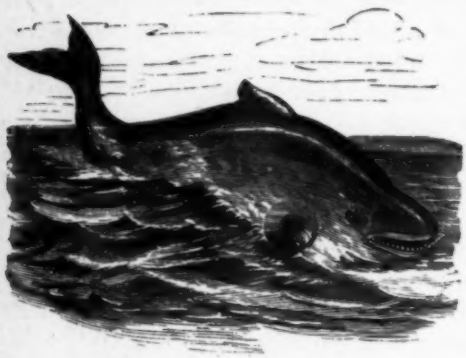


FIG. 3.—COMMON PORPOISE.

While the petrels do not "carry their eggs under their wings and hatch them while resting on the sea," as seafaring men affirmed, yet their domestic life seems to be curtailed as much as possible. They nest in cavities in rocks along the coast or in burrows in the ground, laying a single white egg. This species is said to breed in Florida and the West India islands.

The petrel belongs to the wild wastes of the sea, as the gull belongs to the shore, and the swallow to inland districts. Sea birds are as completely helpless when driven far inland as the strictly land species are at sea. Every now and then we hear of some wanderer from the coast being picked up half dead from exhaustion and fright hundreds of miles from the ocean, having been shipwrecked apparently and blown in thither during a storm. A case of this kind was communicated to me some time ago by a gentleman in Sharon, Vermont, where a specimen of the dovekie, or sea dove, a common bird of the northern New England coast, was found one morning in the fall on a neighbor's porch.

FIG. 4.—SALPA.

The helplessness of our song birds when carried to sea is piti-

able in the extreme. I rarely make a voyage of any length but some small bird is shaken out of a sail where it hid in its fright, or is found taking refuge in the rigging. Once, while off Cape Hatteras, a finch or sparrow of some species came aboard our schooner, showing great fatigue and fear by its tremulous, hesitating flight. Its small wings were of little avail to cope with the wide blue expanse on which distance is so deceptive. It fluttered about from rope to spar, glad to find "rest for the sole of its foot," and although it made short detours—reconnoitring sallies now and then from the boat—I think it invariably returned, and decided to take passage with us to the land.

On a calm evening I saw another larger bird looking like a petrel, swimming about with Mother Carey's chickens. It had long, swordlike wings, and was of a dark slate color above and below pure white. Once a pair of tropic birds crossed our track. We frequently catch glimpses of the bold shearwaters skimming the distant seas, and hear their piercing cries as they dart along the waves, now lost in the trough of the sea or soaring aloft, their breasts white as the foam below.

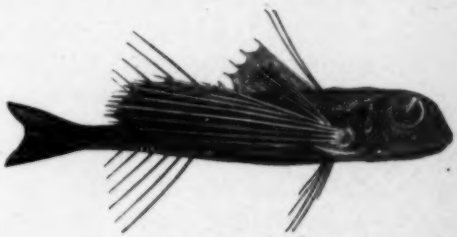


Fig. 5.—Flying Gurnard.

How welcome is every unusual sight and sign of life on the desert sea plains! The great schools of fish ruffling the surface, now and then leaping into full view; the sleek porpoises showing their powerful tails or racing the ship under her bows; the chance shark which dogs the vessel; the splendid physalias, or Portuguese men-of-war. How eagerly the sailor scans the horizon to catch a glimpse of a sail, and the discovery is soon known to every one on board! A mere phantom to an ordinary eye, he tells whether it be schooner, bark, or brig, knows her course, perhaps also where she is bound and what she carries. Now we see the topmasts only of some vessel standing off on the horizon, or the gray form of a ship half screened by the fog. Now a steamer passes us, and the thud of the wheel and clang of its foghorn are heard long after it vanishes in the mist.

I never saw the physalia so abundant as on one afternoon of this voyage. The surface of the sea heaved in long, gentle swells. At times a dozen of these little sails could be counted from the vessel. Those farthest away appear as white, glistening specks. One, unusually large and handsome, floats near by. It looks like a diminutive boat blown out of iridescent glass. Its transparent, gleaming sail, gathered at the edge, is tinged with pink and blue

next the water. Once we dipped one in a net, and placing it carefully in a pail of sea-water, examined it at our leisure on deck. It was then seen to consist of a float or air bag, and thick clusters of pink bodies attached, and longer blue ones which extend down in the water.

Our little man-of-war bears a truer resemblance to a well manned and ordered warship than might at first be supposed, since it is not an individual, but a community of polyp-like ani-

FIG. 6.—ANTENNARIUS.

mals bound together for common support and protection, with a division of labor recalling that maintained aboard a vessel, or, better still, like that seen in a hive of bees. There are four kinds or grades of persons in the physalia community. There are the *feeders*, the pink bodies just mentioned, which procure and digest the food for the whole community, all the polyps communicating freely with each other; the *defenders*, the long, indigo-colored tentacles, which may be distended like flexible threads to the

length of several yards, and which are covered all over with batteries of poison cells, a touch from which is like the sting of a dozen nettles; the *reproducers* are the very small polyps at the bases of the tentacles; while the locomotor *float* represents a polyp or hydra which has become modified the most of all. This float, like a miniature sail, may be raised or reefed by admitting or expelling the air, and if punctured it collapses like a toy balloon.

The physalias are hydrozoa—that is to say, they belong to that large class of marine forms which include, with the little

FIG. 7.—SHIP IN PHOSPHORESCENT WATERS.

green and brown hydras of fresh-water ponds, the highly colored or glass-like jellyfish or medusæ, and those numerous hydroid colonies or branching stocks which often remind one more of small shrubs or some vegetable growth than of a community of animals. Many hydrozoa possess marvelously complicated life histories. By "alternation of generations"—that is, by the regular alternation of a *sexual* generation with one or more generations reproducing *asexually* by budding or division—and by division of labor, an almost unlimited number of individuals with various functions, as we saw in physalia, may arise from a single polyp egg.

Porpoises bent upon voyages of their own pass us at intervals. At each turn in the water we see their huge fins and shining, convex bodies. The porpoise describes a graceful, undulatory line in its course through the water; now appearing at the surface and immediately diving below it, showing itself only as it rounds the crest of each wave. When a number rise together in line, their dorsal fins and backs alone being visible, you are reminded of a great saw with huge, incurved teeth. Here, again, are others apparently at play. How they lash the water into spray with their powerful tails! Now one shoots like an arrow into the air; another jumps, and clearing the water for several feet, enters it again with a plunge. This may be anything but play, however. A whale or some other enemy is perhaps giving them chase, and they are fleeing for their lives.

We saw several whales during this voyage, and on one evening two crossed our bows. They swam side by side, rolling along at an easy gait, much like that of the porpoise, and spouting a jet of spray as they came to the surface to breathe.

At another time a very large school of porpoises was seen advancing toward our vessel. There must have been several hundred of them. They formed a long, not very deep line, swimming in several squads of fifty or more each, and crossed our course without altering theirs. Some passed by the stem or bow, or with a plunge shot under the vessel as if it were a plank. Both dolphins and porpoises like to race with a ship, although it costs many their lives. You can see their brown, spotted bodies and blunt noses as with great speed they shoot to this and that side of the cutwater. The faster the ship goes the greater seems to be the sport. The porpoise is little more than a powerfully muscular tail, developed at the expense of the rest of the body. Most sailing craft carry a spear or harpoon, for the sailors not only like the excitement of taking these animals, but also find in their flesh a welcome variety to the monotonous ship fare.

One morning, as I stood with the captain on the forecastle deck, he attaching his harpoon line as I watched the porpoises, I saw a large loggerhead turtle under the bow, his brown back being barely under water. He appeared to be asleep, but in a moment the vessel struck him, and down he slowly paddled out of sight. The spear did not happen to be in readiness, so that our turtle soup that day was a strictly Barmecide dish.

The number of small invertebrate animals which come to the surface on calm evenings is quite astonishing. Once in May, while in the vicinity of the Gulf Stream, near the Florida coast, there appeared regularly at about four o'clock in the afternoon countless swarms of a brown jellyfish or medusa—"sea thimbles," as sailors call all animals of this class—and this species (*Linerges*)

is about the size of a thimble. The clear indigo water was speckled with them. You could dip them up anywhere in a bucket, and we sailed miles without noticing any appreciable diminution in their numbers. This and like spectacles give us a

FIG. 8.—LUMINOUS FISHES.

faint conception of the incalculable wealth of the sea in living things, and of their superabundance if allowed to multiply unchecked.

Another marine organism seen floating near the surface is three or four inches long and looks like a little roll of white lace with a pink spot in the center. This is a species of salpa, which

belongs to the class of Ascidians, and is especially noteworthy since its embryonic history bears a strong resemblance to that of the lower vertebrates. The life history of the salpas is greatly complicated by the process of alternation of generations seen in physalia, and it was in them, in fact, that this phenomenon was first noticed.

The flight of the flying fish recalls that of some insects. When a ship plows through a school of these creatures, how they scud off on all sides like grasshoppers rising from underfoot in the fields, and by the aid of their gauze wings, the pectoral and ventral fins, fly to a place of safety! From the indistinct halo seen about these fish in flight, from the abrupt turns which they execute, going as readily against the wind as with it, and from their apparently uniform speed, we naturally infer a rapid beating of those delicate wings, as in the case of humming birds and certain insects, and this inference is probably a correct one. Many observers, however, contend that this is not a genuine flight, but scaling. According to this view, the fish project themselves with a great velocity from the water, press with their wings, held at an advantageous angle, against the air, and are thus kept up, while they are carried forward by their own inertia. Their motion would thus be gradually retarded until they finally entered the water again, like that of a stone skimmed along the surface of a pond, while on the contrary their flight appears to be quite uniform. This and other mechanical difficulties, and the fact that the beating of the fins can be clearly seen in other species of flying fish, show that the common belief that these animals *fly* in the strict sense of the word is probably the true one.

The vegetation of the sea is limited to the brown masses of sargassum or "gulf weed," which is most abundant in or along the borders of the Gulf Stream and may be seen growing on the sheltered reefs about Nassau. This alga is especially interesting for the wealth of marine life which it shelters. A large mass, which has been a floating island for some time, possesses in fact quite a varied fauna. If you fish up a handful of it and shake it over the deck, the little animals pour down like rain. Here are crabs and shrimps without number, some of them very delicate, no longer than a pin; barnacles, mollusks, and fish of several species, one of which, the *Antennarius*, regularly lives and builds its nest in these little islands. This grotesque fish is two or three inches long and nearly as broad in a vertical plane, and is variously spotted and mottled with light and dark-brown colors. Its lower fins resemble a pair of hands in shape and function, and its head recalls that of a mediæval war horse armed and plumed.

These little communities furnish a striking instance of the protective coloring of animals, a phenomenon of which there

FIG. 9.—A SUBMARINE VIEW OF THE SHORE AT NASSAU. A sand bottom near a sheltered reef with loggerhead sponges (*Hircinia arcuta*) in the foreground, and buds of seaweed, sprinkled with large white "sea eggs" or sea urchins (*Hippona*). Trunkfish (*Ostracion*) are swimming above.

seem to be nearly as many examples as there are living things. The general cast of the plant and animals inhabiting it is a dull brown. The goose barnacles, which are attached to the sprays in great numbers, have white shell-cases with brown stalks. The crabs are brown with usually a large white spot on their backs, apparently in imitation of the barnacles, while many of the little shrimps are marked in the same way. The spherical floats of the sargassum are, furthermore, incrusted with the white lacelike skeletons of bryozoa. The brown gulf weed is thus dappled with white, and it is evidently advantageous for animals living in it to simulate its colors, which they do in an extraordinary manner. These colors are certainly protective, and if produced by the slow process of natural selection, by which the hue of the organism comes to harmonize with that of its environment, to the evident advantage of the former, we must imagine this species of alga to have floated about with these and similar animals for long ages.

The salpas and medusæ are beautifully phosphorescent at night, and in fact most of the invertebrate life of the sea, which on calm evenings swarms in myriads at the surface, possesses this remarkable power. Then is every ripple followed by a train of glowing sparks, every wave which breaks against the ship by a brilliant meteoric shower. The larger medusæ, which look like softly glowing balls of mystic fire, and the barrel-shaped ctenophores are stars of the first magnitude, while behind there is a whole galaxy of lesser lights, to count which would be much like counting the stars. As I sat one evening watching our rudder, after which trailed a long, curling line of sparks, four small fish made their appearance and swam by the stern for several hours. Their forms were illumined in the black water, and a train of fire followed each as like little meteors they darted after the ship.

We can form at most but a very imperfect idea of the life of the sea from the chance glimpses afforded on the most favorable voyage. We see but transient tokens of that vast life which the sea holds in her teeming bosom.

Could we project vertical sections of the ocean upon a screen and examine these pictures in detail, what revelations might they not unfold! We would have the dwellers in every story of the sea caught in their natural attitudes, the hosts of smaller animals at the surface, the many fish and other monsters of the deep, and those far off dwellers in the abyssal sea. Scientific study with the microscope, the tow-net, and deep-sea dredge is revealing little by little those wonderful forms of life which have been so long hidden from human eyes.

NORTH AND SOUTH AMERICAN ABORIGINAL NAMES.

By M. V. MOORE.

THERE are numerous evidences showing that the same aboriginal peoples who named the waters of North America coined also the prehistoric geographical titles in South America. Scores of actual identities are revealed in the prehistoric nomenclatures of the two portions of this continent. These identities are not only in various terms that appear in the river names which still survive and betray the tongue of indeterminate ages here, but the very same ancient words in full are apparently reproduced in many instances. The reproductions are indeed of such a character as to induce the belief that the earliest civilization of both North and South America had origin in one common ancestry. The oldest nomenclature surviving in the countries both North and South certainly indicates origin in civilization.

We have now no definite knowledge as to how some of the old aboriginal names should be properly written in our English idiom. There are slightly different versions or expressions of the ancient words which have been perpetuated in the idioms of the French, Spanish, and Portuguese—words that are evidently the same thing in remotest origin and structure. From the very beginning of the modern European conquest and colonization, the "Indian" names have been invested chiefly with what is purely a fanciful and conjectural orthography in their English writings. There has been no surviving testimonial, in either living or dead tongues, fixing the definite expression of the ancient words just as the native man would have written them had he been possessed of the proper facilities.

Sometimes the old native names have been made to appear unnecessarily grotesque in their writing—in some instances as much so as the rude savage himself appears personally—the fact illustrated in the writing *Youghiogheney* for simply Ya-og-ha-na, and in *Esquemeaux* for Es-ka-mo. Many purely poetic garbs of the old words have become incorporated into our permanent geographical literature. The names Mississippi and Tennessee are examples of the fanciful versions of the old aboriginal titles: the former is supposed to have been in sounds represented by the English writing *Mes-sis-a-pa*, while the oldest historic records extant showing the latter give the writing as *Ten-as-sa*. What is evidently one ancestral word appears in the modern versions of *Shewanee, Sewanee, Suwanee, Swanan,* and *Chowan*. The French writing *Cheyenne* is the same word in the remote ancestry, as is now believed.

There is a South American river name written in our English idiom *Amaccura*. In Florida we have the old aboriginal title *Amaxura*. No man is now learned enough to maintain, with any assurance of truth or authority in his favor, that from either standpoint, historical or etymological, there is any real or essential difference in the two names.

The same thing may be said of two other well-known ancient "Indian" appellations—*Orinoco* and *Oronoko*, as they are now written in our English versions. The former is a native South American word, while the latter—*Oronoko*—is unquestionably an aboriginal North American river name. A corruption of the ancient name has been applied, as the permanent modern title of the stream, in the word written *Roanoke*, the old initial vowel sound in *o* finally dropped. Our wisest philologists are unable to determine any difference in the true etymology of the two writings, *Orinoco* and *Oronoko*.

Nor can they perceive the real difference—for none exists—in the Carolina river name *Occonee* and the South American appellation written *Ocona*. We have in North America the name *Pawnee;* in South America they have what is doubtless the very same thing in the writing *Pana* (Pawna). We have in New England the native name *Chicopee;* South America has *Chicapa*. (Our authorities tell us that "oopee," "upa," "opee," "ippe," "epe," "apa," etc., are simply dialectic expressions showing one common ancestry—each being a term for water or river in the native tongues of the continent.) We have *Omaha;* South America has *Omagha*. We have *Aboite;* South America has *Abaite*. We have in South Carolina the river name *Saluda;* South America has the *Saladorio*, the Sal-aw-dow River. We have *Tygar* River; South America has *Tigri*. (The Old World has the name written in English *Tigris*—really *Te-ga-ri*, or the *De-ka-li* of the Hebrew; all three of the names—*Tygar*, *Tigri*, and *Tigris*—showing a common though very remote ancestry.)

Chico and *Chota* are found in native names in both North and South America. We have *Choco* and *Choccolocco;* while South America has *Choco-loochee*. "Loochees" and "oochees," or "uchas," without number, are found all over the continent, North as well as South, in the native names of waters. In South America are several *Ubas*, ancient appellations of waters. California has two rivers, the prehistoric Indian names, written *Yuba*. There are scores of "oobas" and "ubas" in the ancient names of waters of the continent both North and South. And what is a more startling feature of the prehistoric speech of the New World is the fact that this same word, or the sounds heard in the writing "uba" or "yuba," is found in the prehistoric water nomenclature of various peoples of the Old World.

South America has *Pachitae;* Georgia has *Pachita.* Brazil has *Paculi,* or *Pacoolee;* South Carolina has *Pacola,* or, as it is written in the old French idiom, *Pacolet,* the final letter silent. Illinois has *Peoria,* an ancient Indian name of a lake; South America has *Piura* and *Peru;* while Louisiana has the bayou name *Pero,* the French idiom rendering the old word as *Perot.*

It is scarcely reasonable to conclude that all these—and many more that are known to exist in the way of coincidences, identities, and similarities in the prehistoric water nomenclature of the continent—are the result of mere accident, or in conformity to any universal lingual law. The vast array of actual correspondences can be accounted for reasonably or properly only on the theory or hypothesis that one common ancestral tongue was known and understood by the race of peoples who overran and colonized the continent in the remote indeterminate past—a race of peoples who so fixed their speech in the river names of the Western world that the words have survived through all the mutations of governments, and through all the changes incident to the human tongue in the countless ages that have intervened since the beginning when the words were first applied here to the waters. It is a very singular and striking fact in human history that the names of rivers or other waters have outlived all other evidences of the prehistoric human speech. There are yet in existence the names of the waters of the very primitive home of man itself, when all other evidences of the Adamic age and tongue have been swept into utter oblivion. We know that the names of most of the waters of the Old World have origin in indeterminate eras: the old word-landmarks have been preserved and perpetuated through the countless changes in nations and tongues since, with no other variations save those incident to the different idioms in the old and the new, our word Nile being the English idiom rendering the Latin *Nilus* and the Sanskrit *Nali.* Rhine is the English of the old *Rhenus* or the older *Rina.* The ancestral germs in the respective words are easily determined and read in each idiomatic expression.

We find in great frequency in the prehistoric river names of both North and South America a word or term that is variously written in our geographical literature as *augua, agua, aqua, auqua, ogga, occa,* and otherwise. Many of the old names have come to us through the early Spanish records, these showing in most instances the Spanish form or idiom in writing the (Spanish) term or word for water or river, *augua.* But we can not believe, with reason in our favor, that wherever the term appears in the writing of the prehistoric names its presence is wholly due to the Spanish influence on the continent. The term occurs in native names in localities where there is no evidence showing that the

Spanish influence was ever felt there. It is found also in sections where the Spaniard did not remain long enough to permanently inject his term *agua*, or *augua*, into the dialects of the aborigines. Indeed, no native tribes or peoples have been known on the continent who have readily adopted the tongue or even the general terms of a foreign race. Even the modern Indians have persistently rejected the tongue of the European.

And yet we have such South and Central American names as the following—titles that are regarded as native or aboriginal—in the modern writings: *Ur-augua, Par-augua, Agua-pi, Nicaragua, Conch-augua, Des-augua-dero;* these and many more showing the same term that is conspicuous in our native Indian appellations, written *Wat-auga, Chicam-auga, Canadian-augua, Nottas-augua, Aut-augua*, and the like, in North America—words that are quite universally regarded as pure aboriginal names, the main term entirely free from the influences of the Caucasian tongue.

IMMATERIAL SCIENCE.

By E. S. MOSER.

THE Material View of Life and its Relations to the Spiritual, by Prof. Graham Lusk, Assistant Professor of Physiology, Yale Medical School, in The Popular Science Monthly for August, 1893, presents to the mind of a layman a unique combination of facts and fancies, of scientific deductions and metaphysical assumptions. The professor's "material view" in the main finds adequate support in the domain of demonstrable knowledge, but his "reasoning" process in support of his spiritual view is distributed over a good deal of imaginative and unknown territory. The professor observes: "Matter is divided into ponderable and imponderable—ponderable, that which can be weighed; imponderable, that which can not be weighed." Some proof is certainly required in support of this statement. The conventional terms of speech employed in treating of matter admit of a division of matter within certain limitations, to more clearly establish the differences in material forms; but to boldly imply that a portion of the matter in existence has no weight—is imponderable—is to challenge the presentation of clearly defined evidence. The professor may be right, he may be wrong. He may believe he is right, yet belief in the absence of knowledge is *mere belief*, and one belief in the abstract is of about as much importance as any other belief, however ridiculous. Moreover, to assume to establish the existence of an "ether" as a means of explaining "something otherwise inexplicable," is a process of reasoning which

may pass at par with very learned metaphysicians, but it can hardly claim the serious attention of thinking minds, *particularly* when the "something otherwise inexplicable" is something the existence of which is taken for granted. The professor continues his process of reasoning: "A man dies; the spirit passes from him; the flesh is left." The synthetical activities of the body which produced the phenomena of life have ceased; the analytical or destructive process is master of the situation; but "the spirit passes from him"! *What* passes from him? What is this *spirit*, professor? "Imponderable spirit" is it? I don't understand you, because I do not know what you are talking about. You may explain that the spirit is ethereal matter. Will I be informed as to what spirit may be or is, when I know nothing about imponderable matter? "And likewise may there not be a spiritual ether surrounding us, a medium through which impulses may come to the spirit from on high, and from the spirit be transmitted to the intellect? Such influences come to us strongly at times, as at the communion table." This may be so, but even your single illustration, as to causation, lacks confirmation. We have observed so-called evidences of "the spirit from on high" in the prostrate forms of persons at sacred altars, persons in a state of unconsciousness produced by brain acting upon brain. I know, if I know anything, that a certain amount of physical energy is involved in every instance of nervous excitation, and that the influence of this energy acting upon *matter* is easily communicated to, and will act upon, willing subjects. Still further: "Now, is it not conceivable that, in the spirit after its severance from the flesh, our present imperfect senses may become perfect, and the influence of other now unthought-of sensations become possible?" No, it is not conceivable, if the conception is to rest upon a rational basis—truths at this time demonstrable. The existence of "unthought-of sensations" is a bold assumption. The conception is not scientific, because our present "imperfect senses" are the outcome of purely physical (earthly) conditions, so far as science knows anything about the senses. What science does not know, or what science may know hereafter, has nothing to do and can have nothing to do with the professor's conception at present.

I concede to every man the right to formulate a belief that will afford him some needed consolation in his struggle for existence, so long as he is perfectly willing to allow other men to do likewise without let or hindrance, but no belief should be set forth in the name of science unless there be tangible evidence produced in support of it.

It is frequently observed that some scientists are loath to accept and to abide by the results obtained as the fruitage of their laborious investigations. They observe the operations of Nature,

closely study causes and effects, discern principles of action, and thereupon formulate truths. Forthwith these truths must be utilized to bolster up preconceived notions which have no foundation in fact. Thus valuable time is wasted, and the progress of scientific research is retarded as well. No scientist should start out in search of nothing. He must have an object in view, and that object must in a measure be defined. Science has no business to halt by the wayside and inquire whether or not the truths found in the book of Nature will horrify those who are nursing some creed or dogma. Truth is truth, and an apology for its existence received from any quarter is quite superfluous. If the truths of science have terrors for a man's religion there must be something wrong and untrue in connection with his religion. If his religion be based upon knowledge, love, justice, and mercy, he will encounter no terrors in the realm of science; if his religion means a desire to know the why and wherefore of existences about him and the determination to add his mite of power in helping to ameliorate human conditions, the truths of science will serve as his handmaiden.

The assumed cleverness and wisdom attributed, in the professor's article, to certain thinkers may apply in some instances, but no one realizes more fully than the student of Nature himself the *fact* that he knows but little and can never know a great deal. But he finds in this reflection no reason why he should quit his labors or even turn aside to ingeniously weave an apologetic yarn, lest his conclusions unmixed with sophistry might possibly horrify some prejudiced minds.

AN ARGUMENT FOR VERTICAL HANDWRITING.

By JOSEPH V. WITHERBEE.

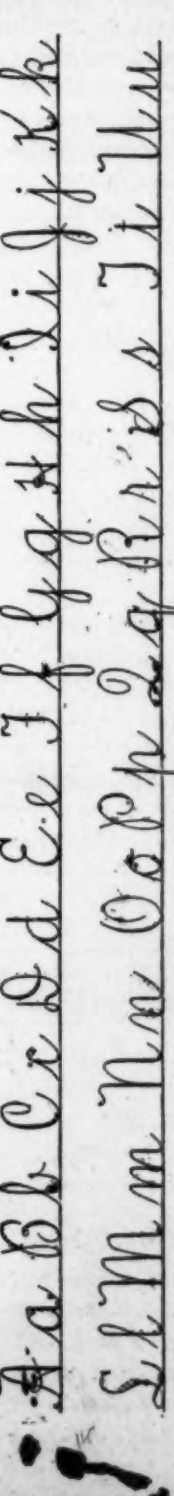
WHY is it that the business men of to-day find so much fault with the chirography of the boys who are seeking, or have obtained employment? They assert with great positiveness that the average boy of thirteen or fourteen years does not write legibly; that his labored copy-book hand, with its pale and sight-destroying hair-lines, is not at all adapted for business purposes. Their cry is for a style of penmanship that is practical, that a boy or girl can write rapidly, and that will not injure their eyes when forced to read it for any length of time.

It is the purpose of this article to show that there is such a style of penmanship, that it is easier to teach, that it is easier to read, that it is more rapid, and that, from a hygienic point of view, it is incomparably superior to the present slanting writing.

In England, I believe, Prof. John Jackson is the pioneer in the new style of writing; and now, so much favor has it found over there, by reason of its superior legibility, that the examiners require its use in all branches of the civil service. Sampson Low & Company, London, have published Prof. Jackson's copy-books, which have had a wide sale in England. Many English schools have adopted them and require their exclusive use. On the Continent the Austrian schools lead in approval and support of vertical chirography, though many of the more progressive German schools have taken up this system and are enthusiastic in its praise. As yet, I believe, no American publishers have issued a series of copy-books with the upright letters, though one house contemplates it in the near future.

From long and careful observation, I think every teacher of a beginner's class in school will bear witness to the fact that the first attempts of a new pupil with pen or pencil are nearly perpendicular, and that it is only by keeping constantly at him that the child manages to make his letters at the required slant of fifty-two degrees. Even then, after all his work with exaggerated copies

VERTICAL COPY-SLIP.



DIRECTIONS.—Sit squarely facing the desk with feet flat on floor. Raise seat so that both forearms, when placed half their length on the desk, are nearly level. Place paper squarely in front of breast-bone. Keep elbows close to body. Sit erect.

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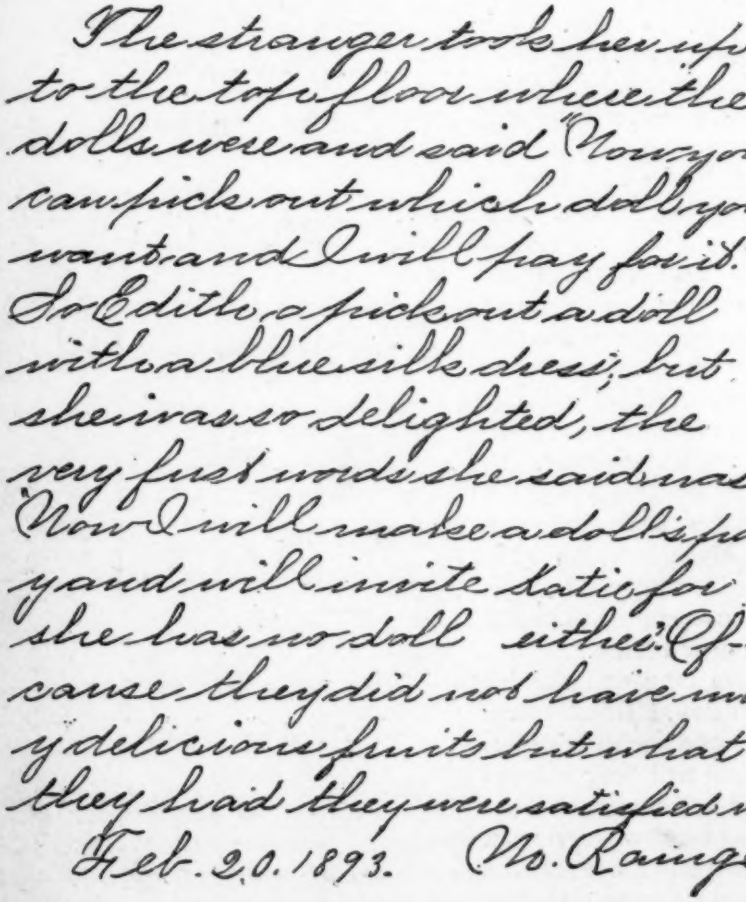
and other devices, if nothing more is said about the slope, he lapses back to his natural inclination to write straight. From this it would seem that the present mode of teaching penmanship is contrary to Nature, and therefore a great waste of energy. How much easier and pleasanter, too, it would be to adopt the vertical writing from the start, and thereby avoid that continual friction necessary to get the artificial slant!

I know not how to make clearer the second point—that straight writing is plainer to read than slanting—than by placing before


The stranger took her up
to the top floor where the
dolls were and said "Now you
can pick out which doll you
want and I will pay for it."
So Edith pick out a doll
with a blue silk dress, but
she was so delighted, the
very first words she said was
"Now I will make a doll's party
and will invite Katie for
she has no doll either." Of
cause they did not have many
delicious fruits but what
they had they were satisfied with.
Feb. 20. 1893. No. Rainge

the reader actual specimens of the same pupil's work, written twelve weeks apart. The pupils selected are twelve and thirteen years old. (It may be well to state here that the class to which these pupils belong had but four weeks' regular instruction of thirty minutes a day, using the above copy-slips, printed on gummed paper, so that they could be readily pasted on the desk immediately in front of the pupil, or on cardboard, as suited the

teacher's fancy. The other eight weeks the class received sometimes two and sometimes three thirty-minute lessons per week.) Let it be understood that these are not isolated cases, but that every member of the class shows the same marked contrast. The slanting writing is part of a composition, while the straight writing was from dictation.

Now let the reader hold the page farther and farther from him until the vertical writing becomes indistinct, and then try his

A time there was, ere England's
griefs began,
When every root of ground main-
tained its man;
For him light labor spread her
wholesome store,
Just gave what life required, but
gave no more,
His best companions, innocence and
health,
And his best riches, ignorance of
wealth.

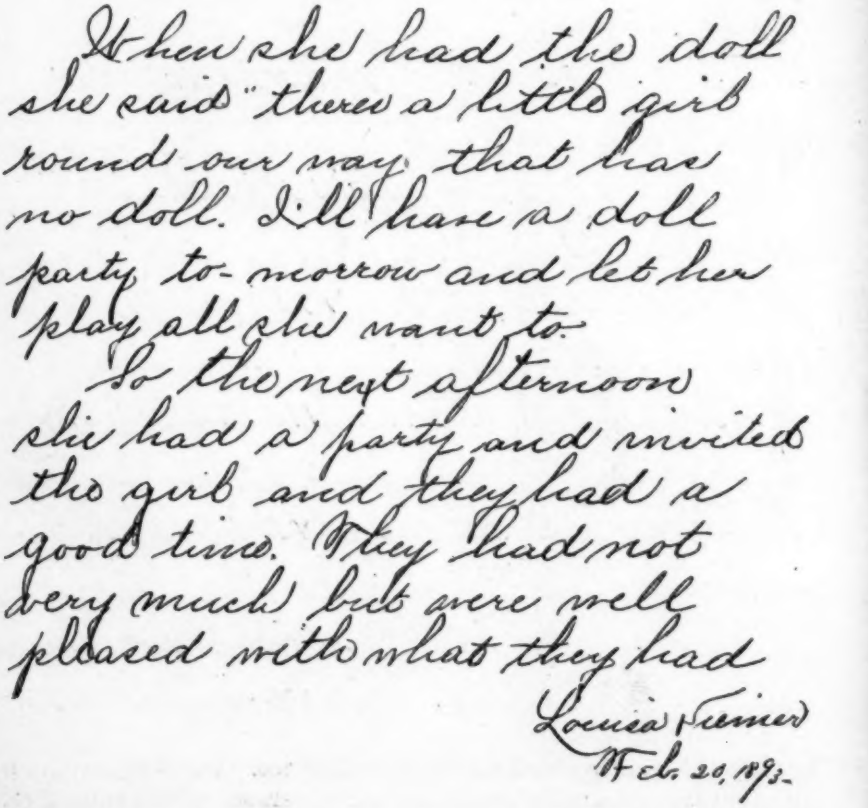
M. Mamie Range
May. 19. 1893.

eyes on the slanting writing at this distance. Unless his sight is different from that of a large number of persons whom the writer has tested, the universal verdict will be in favor of the legibility of the vertical writing. The test becomes much clearer when a short-sighted person, who wears glasses, takes them off and tries to read the two styles of writing. To such people, so plain is the proof that they wonder why straight writing has not been adopted in the schools long ago.

It is claimed that vertical writing can be more rapidly written than slanting for the reason that the perpendicular of every right-angled triangle is shorter than the hypotenuse, and therefore

there is less distance for the pen to travel in making vertical lines than in making slanting lines. The mathematical fact here enunciated will not be denied nor can the deduction be refuted, and yet I fear many will still deny that upright writing is more rapid than sloping writing.

To the parent as well as the educator the position of the pupil when writing should be of the greatest interest. That there is an alarming increase of spinal curvature and near-sight in children of the present day goes without saying. There must be some reason for it. If we accept the statement of the Vienna commission of


When she had the doll she said "there a little girl round our way that has no doll. I'll have a doll party to-morrow and let her play all she want to.

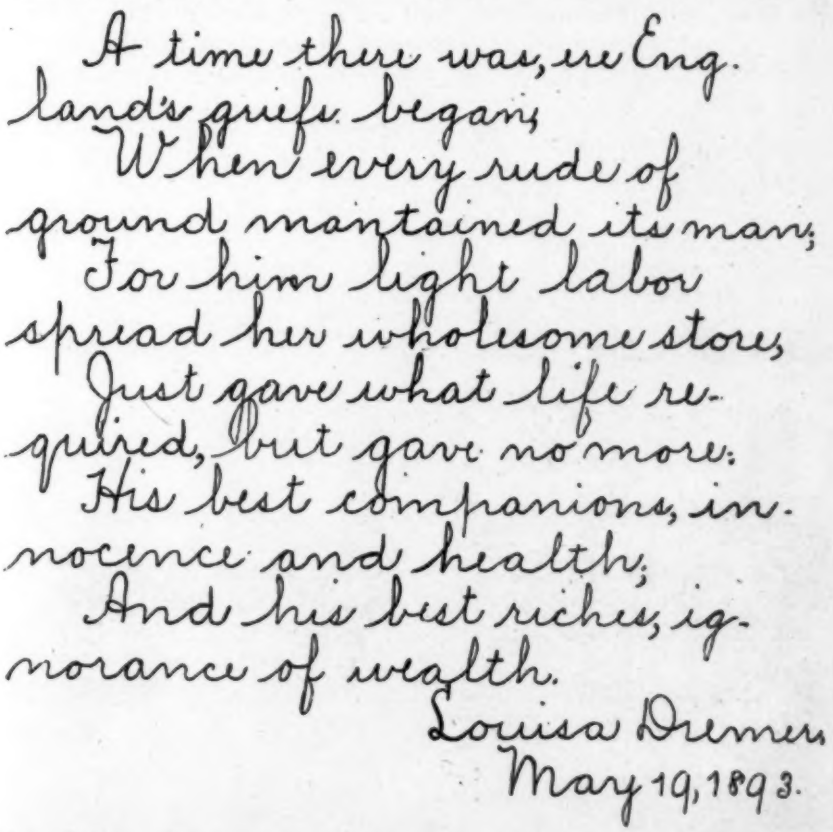
So the next afternoon she had a party and invited the girl and they had a good time. They had not very much but were well pleased with what they had

Louisa Turner
Feb. 20, 1893.

experts appointed to investigate the cause of this increase, we find it charged to the account of sloping writing, with its unavoidable faulty positions. Compare the pictures of two children as actually found in class, and let any one say which child stands the best chance of growing up with a straight spine and unimpaired eyesight if kept in these postures long at a time. Observe that the position of the girl on the right in the first cut is by no means an exaggerated one, but quite as favorable to the advocates of sloping writing as they could ask for, and yet the twisting of the

head and the curvature of the spine are noticeable here, the latter more especially in the second cut. Notice, too, that the other girl, who is in the correct position, might lean forward however much she pleases, and still her shoulders would be of the same height.

If the pupil who slants his letters sits sidewise to the desk (a very common position), not only is one shoulder usually higher than the other, but the head is commonly turned until a line connecting the pupils of the eyes is parallel to the line on which he



is writing. Nature impels him to twist his neck so that one eye shall be the same distance from the letters he is making as the other. Unless he does turn his head, the eyes are not equidistant from his work, which tends to shorten the sight of one eye and lengthen that of the other. This accounts in large measure for the need of two glasses of different power for the same person, so frequently met with at the present time.

It is hardly worth mentioning that vertical writing takes up less space than sloping writing, as this is self-evident and only needs stating to be admitted. Years ago, when paper was costly, this argument would have more weight than now.

Let me digress a little, to enter a protest against the use of double-lined paper after the first year of a pupil's school life, and to express my belief that it is altogether unnecessary in the primary school. A child does not need a walking machine after he has learned to walk; neither does he need a guide-line in penmanship to dwarf his eye-training and judgment of distance after he can distinguish the difference between a whole space and a half space. In my opinion, any child of ordinary ability in the primary school distinguishes half an apple from a whole one, or half an inch from a whole inch—not in name, to be sure, but in reality—long before he enters the school. It is an undisputed fact that the longer a pupil uses the double-ruled paper, the more he misses the guide-line when it is taken away. It has been proved that first-year pupils can get along without the second line from the very outset practically as well as with it, and they thereby

Hygienic position. Unhygienic position.

FRONT VIEW.

avoid learning to write twice, as it really amounts to a second beginning when the single-lined paper is taken up for the first time at the fourth year. In some cities this is the period in the child's school life when much more writing is required, necessitating more rapid work on the part of the pupil. Hence, instead of one difficulty at a time, a long-honored rule of pedagogics, the child loses his guide-line when he has become most accustomed to

it, and is forced to wield his pen more swiftly than before. Is it to be wondered at that children, struggling against these two difficulties at once, show poorer penmanship, as a rule, the first year after dropping double-lined paper than at the end of the first year of school life?

Some educators say that vertical writing is a "fad" that will run its race and die like all fads; but there is this important fact

Unhygienic position. Hygienic position.

BACK VIEW.

to be noticed, that they never have tried it themselves, and, because it is new, therefore it must be fleeting. Grant them that vertical writing is not more legible, more easily taught, and more rapidly written than sloping writing, all false as false can be, the simple fact that it puts the pupil in a perfect position in regard to the spine and the eyes is bound to win its way into popular favor. Vertical writing has come to stay.

THE porcupine, which was living fifty years ago in Andalusia and Estremadura, Spain, has wholly disappeared from these provinces. The ichneumon, Meloncillo, which was formerly common in many places, has become very rare. The Magot monkey is preserved at Gibraltar with much difficulty by frequent renewing of its blood. The Meloncillo ichneumon was a favorite animal with the Spaniards before the domestic cat was introduced, and is still, according to Señor Regnera, greatly esteemed by the inhabitants of the Sierra Morena.

VEGETABLE DIET.

By LADY WALB. PAGET.

I DO not write this paper with the intention of converting or even convincing anybody, for nobody is more impressed with the great truth that what is good for one person is not good for all. The infinite individuality of the human race is what distinguishes it from animals. A certain kind of food will be liked and digested by all animals belonging to the same species, while, as an eminent doctor remarked the other day, there is not one article of food in the whole world which is eaten with pleasure by every human being alike. All I wish to do is to put my experiences before those to whom they may be useful, and who may profit by them without making the disagreeable mistakes my ignorance led me into.

I have all my life thought that meat-eating was objectionable from the æsthetic point of view. Even as a child the fashion of handing around a huge *grosse pièce* on an enormous dish revolted my sense of beauty; and I was delighted when, on my first visit to England, a small and thin slice of beef was unobtrusively shown to me behind my left shoulder, to be accepted or rejected *ad libitum*. I quite agree with Lord Byron, who said he would not marry a pretty girl because she had asked for two helps of lobster salad, though if beefsteak had been substituted I should understand it better still. The *biftek à l'anglaise*, which seems to be the only idea a foreign waiter ever has when he is asked to suggest something to eat to English-speaking travelers, is simply a piece of hot raw meat, far more fit for the Zoölogical Gardens than for human food; for, despite of constant and sometimes indignant disclaimers, it is generally believed on the Continent that it forms the staple food of the British nation—that the strong limbs of the young men, the lovely complexions of the girls, and the bright eyes of the children are entirely due to this nourishment, and anxious mothers of families abroad are constantly impressing upon their offspring and everybody else about them the utility and necessity of this panacea, if they wish to be in good health and feel fit and strong. It is a curious fact that in places where this regimen of *viande saignante* is followed anæmia is very frequent.

I have been told, though I have not read it myself, that somebody has written a description of a town where the whole population was vegetarian. The change this would make in all the sights and smells is far greater than we at first imagine. The ghastly butchers' shops which meet one at every turn appear to me an incongruity, not to say more, in this civilized age; they

would disappear, as well as the fishmongers', which are hardly any better. Then there are the sausage shops, which, especially in southern countries, persecute one with their pungent odor. How often have I been driven away while admiring the façade of an old *palazzo* or the portico of an ancient church by the emanations of the terrible *pizzicheria* half-way down the street! Another dread sight which meets our eyes abroad, especially in Germany and Austria, where much veal is eaten, are the slaughtered calves paraded about the streets, a dozen or two of them hanging over the sides of the cart. There can be little doubt, too, that our kitchens and dining-rooms would be far more sweet and attractive if no animal food was ever brought into them. The eyes certainly would be gainers, and our olfactory senses too. In pictures and in poetry the tables are laid out with luscious fruit and sparkling wines, whenever charming and pleasant scenes are to be conjured up before our minds. When coarseness and discomfort are portrayed, "men brought in whole hogs and quarter-beeves, and all the hall was dim with steam of flesh." It is the difference between one of Giulio Romano's garden banquets, such as he painted in the vaulted chambers of the Palazzo del Te, and a peasant orgy by Ostade or Teniers.

It is not, however, this aspect of the Pythagorean *régime* which will make many converts, nor did it ever influence me for very long, as most doctiors lay, or rather laid, about twenty years ago, so much stress upon the eating of sufficient meat and the anæmic tendency of this generation, that one naturally felt it one's first duty to prefer health to beauty.

A more serious consideration, and one which grew upon me every year, was the sad and distasteful necessity of killing a living being in order to live one's self. The great mystery of pain in this world, which if it once gets a hold upon the mind is so terribly difficult to shake off, often dimmed my greatest pleasures. But this feeling too I tried, but less successfully, to subordinate to what I then considered right and reasonable.

The first serious shock I experienced in this theory was when, a few years ago, one of the most eminent German professors from a great university dined at our table, and would not touch anything because he was a vegetarian. I looked over the bill of fare, and realized with consternation that everything down to the sweet was either meat or fish or fowl, that vegetables and farinaceous food played the very smallest part in it, and even they were tainted with sauces not free from reproach.

I had the evening before listened to an historical discourse delivered by Prof. O—— to an audience of all that is most intelligent and distinguished in this city. I had been struck by his extraordinary vigor and clearness. The words dropped like pearls

from his lips, and though the voice was scarcely raised it appeared to search out the remotest corners of the hall. Every rounded-off sentence presented a vivid picture to the mind. The subject was the chancellor Prince Metternich, and we all felt when, after an hour and a half, Prof. O—— ended apparently quite as fresh and collected as when he began, that we not only knew the prince personally, but that we understood his politics and the workings of his mind far better than his contemporaries had done. The thing which, however, impressed me most, was the sense of power held back, and to the good as it were, which the professor gave me while speaking, and even after he had finished. When, therefore, the next day he told me that he never touched animal food, I was very curious to hear his experiences.

He told me that some years before he had been very ill, nigh unto death, and given up by all the doctors. Then came one who said he could cure him. All the strong soups and beef jellies and raw minced meat were eliminated and replaced by fruit and light farinaceous food, but fruit especially, and he soon got well and strong—so well and strong, indeed, that he determined to go on with his simple fare, especially as he felt an unwonted ease and extraordinary lucidity of the intellect when working. His wife, he told me, soon followed his example, and also his daughters and sons-in-law. At last his servants came and said they would like to be vegetarians too, as it seemed to agree so well with their masters. I felt that where so clever a man was so fully convinced of the expediency and efficiency of this diet that he carried his whole family and household with him, he must have gone into the question deeply, and have the very best reasons upon which to found his belief. I could not enter with him into further discussion, as he had to leave Vienna, but he sent me some books on the subject. These books were German, and they would be well worth translating, for their whole tone is like a bracing mountain air. In every one of them vegetable diet is the foundation whereon is built an edifice of hygiene, which if we could or would but strictly follow might bring us to a pinnacle of animal spirits and bodily vigor only to be compared to the centaur of Henri de Guérin. To those who have not read this charming fragment, let me recommend it as a tonic on a day of languor and prostration. The thorough enjoyment of life and strength in which the centaur revels while careering over wind-swept plains, down breezy mountain-sides, plunging into deep green forests with the scent of the earth and wood flowers in the air, is better than any dose of sal volatile or quinine. These little German books, for none of them are very long, have mainly for their object to bring us back to a healthier and simpler mode of life. They are full of cold water and open windows by day and by night. Sun-baths and

air-baths in the woods and on the hills, swimming and gymnastics, everything on the simplest and most economical lines, as they are mainly written for schools and the middle classes, where expensive adjuncts must be omitted. No medicines are tolerated by the strict vegetarian; everything is cured by diet, exercise, water, hot or cold, or in the shape of steam.

There are now all over Germany and Austria a great number of what are called "Nature doctors," who cure on these principles, though they need not necessarily be vegetarians. The poor prefer them, as they are often men well off, who have a vocation for this calling; the medicaments cost very little or nothing. Father Sebastian Kneipp, at Wörichshofen in Swabia, belongs to this class, and the thousands he cures every year have made his name famous in all the German-speaking lands. He too deprecates the use of much meat. Everywhere baths and sanatoriums are springing up where cures with these simple means alone are effected, and medicines utterly discarded. The Hygeia, a publication founded by the well-known Dr. Paul Niemeyer, and edited at Munich by his disciple and successor, Dr. Gerster, is one of the many organs of the new and independent school; many doctors and a few laymen write in it. It is interesting and amusing, full of unexpected information, and much read by the most intelligent section of the public. The German vegetarian books are full of a number of excellent recipes for dishes of all kinds, suited to every time of the year and to different countries, which is most important, for the new-fledged vegetarian always thinks he is going to die of hunger. In the preparation of vegetables the German Pythagoreans bear off the palm, and I am bound to say that even their puddings and sweets are better than those known to the meat-eater. From what I have heard of English vegetarianism, I fancy that the movement, which in many respects might prove so useful, is much impeded by the inadequate way in which the vegetables are cooked, and until this defect is thoroughly remedied, and a greater variety is introduced into the vegetarian bill of fare, there is no prospect of an extension, which might prove so great a boon to the poorer classes.

In spite of the persuasive language of my books, and the promise of health and happiness, I could not, somehow, make up my mind to take a step which I imagined would in a certain way cut me off from my fellow-creatures; and it was not till rather more than a year ago, when I was obliged to read up certain papers about the transport of cattle and slaughter-houses, that the irresistible conviction came upon me that I must choose between giving up the eating of animal food or my peace of mind.

Years ago, when I lived in Italy, this same subject had given me much pain. At Rome it was the habit for every butcher to

have his own boys in the slaughter-houses to kill the cattle. These boys were often unskillful or not strong enough. When the beautiful milk-white oxen, with their large, pathetic black eyes, were brought to be slaughtered, these butcher boys had often to give thirty blows before the poor beast fell. Every animal that was brought into the town paid by weight at the *octroi*, but they were generally kept waiting for days in sheds outside the town. In these sheds there were drinking-fountains always running, but the plug at the bottom was taken out, so as to prevent the animals from drinking, and thus their weight was lightened. The railway companies never dreamed of watering the cattle during the many days that they were packed together in the trucks, sweltering and faint under the fierce Italian sun. The Roman Society for Protection of Animals sent a dozen pails to Foligno, a central railway station, offering to pay a certain sum annually for the watering of the cattle. The pails were returned after two years, never having been used once. Nor are things much better in this country. The cattle which come up from Transylvania and other distant parts of the empire are neither fed nor watered on the journey, which sometimes takes a week. Then when unshipped they are tied together in threes and fours, hit and frightened, and thus driven to the slaughter-houses. They sometimes fall down in the road from terror and exhaustion.

Galician pigs often lie in thousands for a week together in the snow and slush outside the slaughter-houses, waiting to be killed. Thus far my own experience and things I have seen. In England, if I am to believe newspaper paragraphs and statistics, things are as bad if not worse. For a short *résumé* of the horrors attending the transport of cattle by land and by sea, let anybody whom it interests turn to pages 65–69 of Dr. A. Kingsford's Perfect Way in Diet, headed The Sufferings of Cattle, and they will learn well-authenticated facts which will fill them with pain and disgust. The following figures are sufficiently significant. They are taken from the report of the Veterinary Department of the Privy Council for the year 1879.

In 1879, 157 cargoes of Canadian cattle were shipped for Bristol, Glasgow, Liverpool, and London, in which total there were 25,185 oxen, 73,913 sheep, and 3,663 pigs; but of this number 154 oxen, 1,623 sheep, and 249 pigs were thrown into the sea during the passage, 21 oxen, 226 sheep, and 3 pigs were landed dead, and 4 oxen and 61 sheep were so wounded and suffering on arriving that they had to be slaughtered on the spot. In the same year there were shipped from the United States for the ports of Bristol, Cardiff, Glasgow, Grimsby, Hartlepool, Hull, Leith, Liverpool, London, Newcastle-on-Tyne, South Shields, and Southampton 535 cargoes of animals, of which 76,117 were oxen, 119,350

sheep, 15,180 pigs; but of this number 3,140 oxen, 5,915 sheep, and 2,943 pigs were cast into the sea during the transit; 221 oxen, 386 sheep, and 392 pigs arrived dead at the place of landing; and 93 oxen, 167 sheep, and 130 pigs were so mutilated that they had to be sacrificed on the spot. In *résumé*, 14,024 animals were thrown into the sea, 1,240 were landed dead, and 455 were slaughtered on the quay to save them dying of their wounds and sufferings. One asks one's self what state the remaining animals were in, which were sold for human food?

It is not an unnatural or far-fetched idea to connect this state of things with the excessive and inexplicable extension of cancer within the last decade. The more and the further cattle are transported under these conditions, the more tainted (though perhaps not perceptibly so) meat must be eaten, the more poison is infused into the blood. It is not possible that the flesh of an animal which has been knocked about, frightened, starved, exposed to the heat of the sun or icy cold for days and weeks, should be as healthy as that of those taken from our own fields and slaughtered at once, as was the case in the days of our ancestors.

These considerations, however, were not the only ones that moved me. I do not think that anybody has the right to indulge in tastes which oblige others to follow a brutalizing occupation, which morally degrades the man who earns his bread by it. To call a man a butcher means that he is fond of bloodshed. Butchers often become murderers. I remember two cases in the papers last summer where butchers had been hired to murder individuals whom they did not even know. After this comes the irrepressible thought, Is it right to take life in order to feed one's self, when there is plenty of other available food which will do just as well?

Having answered these questions to my own satisfaction, I plunged at once into full-blown vegetarianism. I got very little to eat, and that not very good, for neither I nor my cook was *à la hauteur* of the situation. I had, however, one, and that a very great compensation—I felt superior to my fellow-beings, treading on air, my head delightfully clear, and altogether lifted up above material things. The poet laureate's lines to Fitzgerald will give in a few words the story of my first and unsuccessful attempt:

> "... live on milk and meat and grass;
> And once for ten long weeks I tried
> Your table of Pythagoras,
> And seemed at first a thing enskied
> (As Shakespeare has it), airy-light,
> To float above the ways of men,
> Then fell from that half-spiritual height
> Chilled, till I tasted flesh again."

I, too, felt chilled and sleepy by day and night, so tired that I could hardly walk. The doctor said: "You have no pulse at all, and must give in; it does not suit you." The winter was icy cold and depressing, and for the moment I followed Tennyson's example. *Mais je ne reculais que pour mieux sauter*, and with the first breath of spring, when all those delightful fruits and leaves and roots which Raphael did not disdain to paint as ornaments in his loggias reappear on our tables, I made my second methodical and successful attempt, eliminating week by week one kind of animal food only, and replacing it by some equally nutritious vegetable preparation.

The very strict ascetic sect of vegetarians who only live upon seeds and uncooked food look down upon their weaker brethren who eat eggs and milk and butter, in fact, everything which does not necessitate the taking of life, which appears to me to be the only reasonable standpoint. I will not, therefore, enter into discussions whether our teeth are those of a carnivorous or frugivorous animal, though the latter appears to me the most likely theory, as fruits are the only edibles we can eat and digest without cooking; everything else requires the aid of fire to make it palatable and wholesome. It is certain that the giving up of animal food cures many illnesses which no medicines can reach. Everybody knows the bad effects of butcher's meat in gout and rheumatism. In affections of the heart it is often the only remedy, and the wonderful results are not difficult to explain in a case where rest often means cure, if one reflects that while the meat-eater's heart has seventy-two beats in the minute the vegetarian's only has fifty-eight beats, therefore twenty thousand beats less in the course of the twenty-four hours. Insomnia and nervousness are affected in the same way; there is less wear and more repose in the constitution. I could enumerate many other illnesses in which vegetable diet does marvels, but will only mention those of the skin. Most vegetarians have unusually clear and often beautiful complexions. I need only remind those who know them of the old Carthusian and Trappist monks, who all have smooth white and pink *Fra Beato Angelico* kind of faces, which are not found among the orders that do not habitually live on Lenten fare. The splendid teeth of the Italian peasantry, who never touch meat, speak for themselves, and it is the same in other countries where the people live under similar conditions. It is foolish to associate vegetable diet with temperance, as so many do: they are quite astonished to see a vegetable-eater drinking wine or beer. One thing, however, is true, viz., that it is far easier to cure a drunkard if you deprive him of meat, because, as Dr. Jenkson, head doctor of the Asylum for Dipsomaniacs, Dansville, United States, says: "It is clear that meat contains some not nutri-

tious particles, which excite the nervous system so much that it at last becomes exhausted and unstrung. In this state of exhaustion unhealthy reaction follows, which brings on a paroxysm and violent desire for spirits and the excitement which they create." G. Bünge, Professor of Physiological Chemistry at the University of Bâle, writes, in his book on vegetarianism, page 33: "The appetite of the drunkard is directed almost exclusively to animal food, and vegetarians are quite right when they teach that spirit-drinking and excessive use of animal food are in connection with each other."

Vegetarianism is often called a fad, but it is a healthy and an innocent one, and the natural reaction against the present state of things. It imparts lightness and elasticity to the body, brightness and clearness to the mind. The vegetarians I know are all unusually strong, active, and young-looking people for their age: one of them walked without stopping for thirty-four and another time twenty-seven hours, without a rest, while on an excursion in Norway, feats not easily equaled by the most inveterate beef-eater. Traveling, mountain-climbing, all seem easier and less fatiguing on this light and soothing diet; and why should it not give strength to the limbs and sinews if one reflects that all the strongest animals who do the heaviest work in the world, like horses, oxen, and elephants, are entirely herbivorous?

There is, of course, a great deal more to say on so wide a subject, but I have in these pages confined myself almost entirely to my own experiences. Being but a beginner myself, there is much for me to learn, and I have not even touched on the possibilities and probabilities this theme opens out into the domain of psychology. But only a few days ago one whose experience and knowledge on this subject are greater than those of most men told me he owed almost everything he had attained in his domain to his strict adherence to a vegetable diet. It certainly gives, to those who live on these lines, a kind of detachment from material things, a sense of calm and content. It is in the hope of helping some who may feel nervous and worried in mind, or ill in body, that I write these lines, to point out a simple remedy everybody can apply. It not only costs nothing, but even puts money in our pockets—only, like everything else, it must be governed by good sense and reason in order to be successful.

It is not my intention to be understood to say that I look upon vegetable diet, even with its necessary accompaniments of fresh air, frequent ablutions, gymnastics, and exercise, as a panacea for everything, and that medicines become useless. We are mortal, and there is no perfection in this imperfect world. Nobody has a greater belief than I have in remedies judiciously given during illness, but it is the many who are out of health and below par,

without hardly knowing what is the matter with them, who would be all the better for trying whether their discomforts spring from too high and rich a diet or from the inability to procure any but inferior meat or fish. In the first case they would soon feel their tired digestions rested and their irritated nerves calming down, while in the latter they would find out that it is easy to get a healthier and an equally satisfying meal for half the cost of what they were in the habit of spending before.

Though these motives are not perhaps the highest which ought to lead us to a result, they are those which exercise a most general influence. The small number who change their mode of life from principle only know how far above bodily health the blessings are which grow out of the sacrifice. Before the eyes of everybody the lines of the Latin poet must conjure up a delightful and attractive picture:

"Forbear, O mortals, to taint your bodies with forbidden food;
Corn have we; the boughs bend under a load of fruit;
Our vines abound in swelling grapes; our fields with wholesome herbs,
Whereof those of a cruder kind may be softened and mellowed by fire.
Nor is milk denied us, nor honey smelling of the fragrant thyme;
Earth is lavish of her riches, and teems with kindly stores,
Providing without slaughter or bloodshed for all manner of delights."

ORIGIN OF THE MISSISSIPPI VALLEY RAINFALL.

By J. HARRIS PATTON, Ph. D.

IT has been assumed that the evaporation off the Gulf of Mexico furnishes the most part of the rainfall of the great valley. Says an authority, when speaking of that of the whole country, "By far the greater portion comes from the gulf and spreads over the central and eastern part of the Mississippi Valley, and even much of the Atlantic slope." Let us examine the data on which this statement is based. The area of the Mississippi Valley is estimated at 1,244,000 square miles, and the annual average rainfall on its surface is forty-two inches—that is, if the rain water did not penetrate the earth, run off, or evaporate, at the end of the year the depth would be three feet and a half.

The area of the Gulf of Mexico is estimated to be one fourth that of the valley. It is easily shown by mathematical calculation that it would require an annual evaporation off this area of fourteen feet to furnish the required rainfall, even if all the water thus raised into the atmosphere were utilized. Again, the area of the gulf is swept by the extreme right flank of the trade winds. These winds must carry toward the west a large portion of the

surface vapor rising off the gulf; this is evident because of the unusual distance to which the sea-breeze penetrates into Texas and the adjoining region of Mexico. In addition, the water of the gulf is not as warm as that of the Atlantic equatorial current—to be noticed presently—by an average of *ten* or *twelve* degrees Fahr., and in consequence, in proportion, its evaporation is just so much the smaller. The equatorial current penetrates the gulf about five hundred miles, but does not diffuse itself and thus impart its heat to the adjoining waters, but in a compact body the current turns toward the east and finds its way out through the Florida Strait, and thus becomes the Gulf Stream.

It is estimated that if the "gulf was landlocked and evaporation checked," the volume of water poured into it by the Mississippi alone would "raise the level of this great area one and a quarter feet each year." (Appletons' Physical Geography, p. 130.) The height of the surface of the gulf, however, remains uniformly the same year in and year out. It follows from this that the outflow of water and its evaporation combined amount each year to only one foot and a quarter. This leaves twelve feet and three quarters to be obtained elsewhere, in order to furnish the rainfall for the great valley. The question is, Where can this be obtained?

The Atlantic equatorial current may furnish an answer. This vast stream is about four thousand miles long and about three thousand wide. Taking its rise in the Gulf of Guinea, it flows westwardly, but, dividing on Cape St. Roque, the much greater portion moves along the north shore of South America, and just before entering the Caribbean Sea it unites with the northern counter current. (See Appletons' Physical Geography, pp. 50, 51.) These currents are both under a broiling tropical sun, and their water is heated from 80° to 82°; "the evaporation is rapid in the equatorial regions, and most of all in the warm belts constantly swept by the trade winds." Thus, when the warm, saturated air next the surface rises, it is rapidly carried away by the wind, and cooler air flowing from the north takes its place, to be in turn heated and floated upward. Says Captain Maury, U. S. N. (Geography of the Sea, p. 102), "Off this ocean belt there is, in the form of vapor, annually floated up into the higher air fifteen feet of water." Says Prof. Arnold Guyot, in Earth and Man, p. 85, when speaking of the same, "The sun causes these invisible vapors to rise, which, being lighter than the air itself, increasingly tend to soar into the upper atmosphere, filling it and constituting within it another aqueous atmosphere." This vapor is carried by the trade winds steadily westward at the rate of about thirty or thirty-five miles a day, and meets its first obstruction in the plateau of Mexico, which is five thousand feet above sea-level. On the west coast of Mexico stand the Sierra Madre Mountains, whose altitude

is five thousand feet above the plateau (Appletons' Physical Geography, p. 23). The latter furnish the second impediment to the onward progress of these winds, since they run southeast-northwest; but the trades blow directly west, and thus impinge upon them at an angle which deflects the winds themselves toward the north.

The Sierra Madre are more than one thousand miles long, and are an insuperable barrier to the progress of these vapor-loaded winds. This is evident, as there is no indication of their presence on the west side, neither on the land nor on the water, as the Pacific trade winds appear to originate about one hundred and fifty miles west of the coast of Mexico. An analogous case is cited by Prof. Orton, in his Andes and the Amazon, p. 118, who says, when speaking of the Andes, "So effective is that barrier that the trade winds are not felt again on the Pacific till you are one hundred and fifty miles from the coast."

These winds appear to be shoved up, strata upon strata, on the Mexican plateau, and when they finally reach the Sierra Madre Mountains, over which they can not pass, they are rolled back upon themselves. They must have an outlet. The rushing wind from the east prevents their moving in that direction, and the force of the main current forbids their flowing toward the equator, and thus their outlet can only be toward the north. They are now so high that they must be beyond the influence of the rotary motion of the earth, and are governed by the force of gravitation alone. In accordance with the latter law they flow, as on an inclined plane, over the colder and more dense air toward the north, and thus restore the equilibrium of the atmosphere that has been disturbed. This disturbance is caused by a continual flow of the cold and heavy surface air from the extreme north toward the equator, because along the tropical belt a partial vacuum is created by the air becoming heated and lighter and in consequence floating upward, and the cold air rushes in to supply that vacuum.

These comparatively warm strata, though high in the atmosphere, have a tendency to reach the earth, but, being lighter than the surface air, they float above it until their respective densities are about the same. The point of contact with the earth of the *lower* strata of these "return trades" is near 30° north latitude in the summer, but still further north in the winter. This point of contact is near and along the north shore of the gulf, and the blending of the moisture of the "return trades" with that off the gulf may account for the unusually large rainfall of sixty inches near that line; meanwhile the main and higher strata blow on and reach the earth further north.

"The polar winds, seeking the equator, strike obliquely against

the Rocky Mountains, and in running along their eastern slopes are deflected to the southeast, and become the northwest winds of the valley of the Mississippi. . . . These cool winds meet the surplusage of the moist return trade winds, and by their coolness condense still more the latter's vapor, which descends in rainstorms that are sometimes quite violent, but furnish water for the head streams of the Missouri and its branches" (Prof. Guyot, Earth and Man, p. 100).

It has been suggested that this warm air, thus saturated with vapor, loses the latter when it floats aloft, because of the cold in the higher regions of the atmosphere, and consequently such air, floating north, could not deposit moisture when it reached the earth. That theory is not consistent with the fact that vapor often becomes visible in the form of clouds, which frequently float higher than the altitude of the Sierra Madre. In this special case it is worthy of notice that the plateau of Mexico is five thousand feet above sea-level, and it is also under a tropical sun, and therefore the incumbent air is so much the more heated. In such circumstances the vapor-loaded winds would not be likely to lose so much of their warmth and moisture as under conditions wherein there was no similar elevation. The great valley being free from mountain barriers at both ends, the winds flowing either way are unobstructed. In consequence, the comparatively warmer and vapor-loaded winds off the equatorial current meeting those coming from the north that are nearer the surface and also cooler and drier, the moisture of the former is condensed into mists and clouds, and finally descends to the earth in copious rains.

One of the most perfectly adapted pieces of machinery for handling heavy weights is the modern "rapid-transit elevated railway traveling crane," which has been found highly useful in manufactories of locomotives and other ponderous machinery. Before it was introduced, heavy weights were moved from one part of the shop to another by means of jib cranes, the arms of which swung in arcs of a circle. A series of them occupied the middle of the floor. The weight to be moved was swung upon one of them and borne round to the next, when it was changed; and so on, till it reached its destination. These machines cumbered the floor, and were otherwise inconvenient. The traveling crane requires no floor room, but is wholly poised above. It consists of four essential parts: (1) the elevated tracks, which are supported by iron columns or built into the walls and run parallel with the walls from one end of the building to the other; (2) the traveling bridge, which is constructed of two parallel plate girders extending from rail to rail, spanning in mid-air the breadth of the building and mounted on wheels; and (3) heavy steel tracks laid between the girders, bearing (4) a trolley car, which runs back and forth, carrying the hoisting mechanism. By the longitudinal motion of the bridge and the cross-motion of the trolley, every square foot of available space in the building can be covered, and the position of a steam boiler or of a locomotive engine changed at will.

MATHEMATICAL CURIOSITIES OF THE SIXTEENTH CENTURY.

By M. V. BRANDICOURT.

IN the great intellectual revival of the sixteenth century, mathematics as well as letters and the arts were recuperated first from the pure sources of antiquity. Casting away poor Latin translations, second-hand versions through the Arabic, on which the Middle Ages had fed, geometricians emulated one another in zeal for learning the Greek language, in order that they might read in the original text the works of Euclid, Archimedes, Ptolemy, and Diophantus. Most of the works published at this epoch were only translations from Grecian authors. "The great thought of that time," says Montucla, "was simply to refine the minds of students and cause them to taste of a learning almost unknown till then. This could not be done all at once, and the human mind, like a weak stomach which too solid food would tire out, had to be brought by degrees to considerations of a higher order."

One of the earliest translations of Euclid is found in the *Margarita philosophica* of G. Reisch, prior of La Chartreuse at Friborg—a Latin book printed in Gothic characters at Heidelberg in 1496. It is a sort of encyclopædia of the science of the beginning of the sixteenth century, and certifies to the very extensive knowledge of the author. Each of the scientific treatises contained within it is adorned with very curious engravings of a naïve character.

Memmius, a noble of Venice, made a translation of the works of Apollonius in 1537, which was published after his death by one of his sons.

The mathematical sciences were then cultivated with most success in Italy; and when Francis I, of France, sent across the Alps for architects, painters, and sculptors to construct and adorn the magnificent châteaux of Chambord and Chenonceaux, he was thus also able to ask for his colleges algebraists who were certainly the first mathematicians in Europe. Algebra was not then what it has since become, a science employing only letters, signs, and symbols, having a well-defined significance and serving as the characters of a very clear and very precise language, which the initiated could understand as well as they could their mother tongue. The unknown quantity was then called "the thing" (*res, coser;* from which algebra was for some time named the art of the thing), and it was often represented by R. The square of the unknown quantity was called census (2). The signs + and = were not known, but the initials of the words for which they stand

were used. The sign — was not required, for the fruitful theory of negative quantities was not as yet known. In equations the coefficients of the unknown quantities were always figures, which became combined with the other factors during the operations, and of which no trace appeared in the final result. "We may conceive," says M. Chasles, in his History of Geometrical Methods, "that this cramped condition of imperfection did not constitute an algebraic science like that of our days, the power of which resides in those combinations of the signs themselves which assist the reasonings of intuition and lead by a mysterious way to the results sought."

Tartaglia Nicolo was an illustrious figure among the mathematicians of Italy. Born at Brescia in 1500, he was terribly mutilated at an early age, when his native city was captured by Gaston de Foix. His skull was broken in three places and his brain exposed, his jaws were split by a wound across his face, and he could not speak or eat. He nevertheless recovered, but always stammered, whence his name (*tartagliare*, to stammer). He was his own schoolmaster, and, after he had learned to read and write, devoted himself to the study of the ancient geometricians. At thirty-five years of age he taught mathematics in Venice. There he accepted a challenge which Fiori sent him, to solve twenty problems, all of which depended upon a particular case of cubic equations. Tartaglia solved them in less than two hours, and to commemorate his triumph composed mnemotechnic verses containing the solution. He was also the author of the ingenious formula for finding directly the area of a triangle of which all three of the sides are known.

Cardan Jerome, who was born in Paris, of Italian parents, September 24, 1501, was one of the most extraordinary men of his time. At twenty-two years of age, when he had just terminated his studies at the University of Pavia, he taught Euclid publicly. He also taught medicine, traveled in Scotland, Germany, and the Low Countries, and returning established himself in Rome as a pensioner of Pope Gregory XIII, and died there in 1576. Scaliger and De Thou assert that he had calculated the day of his death by astrology, and then starved himself to secure the fulfillment of his predictions.*

Such was the final eccentricity of this mathematician, who believed firmly in astrology and had visions, and he professed that

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* In one of his excursions to England he cast the horoscope of Edward VI, for whom he predicted a long life. Unfortunately, the king died in the next year. Having become used to such accidents, he was not disconcerted, but revised his calculations, rectified some of the figures, and found that the king had died in full accordance with the rules of astrology.

he had been informed in a dream of all that was to happen to him. His costume, his bearing, corresponded with his strange character. He appeared sometimes in rags, sometimes splendidly dressed; ran through the streets at night, and the next day was drawn in a three-wheeled carriage. Yet he published a treatise on mathematics, *Ars magna*, which was remarkable for the age. Pertinently to the publication of this work he had controversies with Tartaglia, of which something should be said, for the curious picture they offer of the manners of the learned world in the sixteenth century.

Tartaglia, as we have said, discovered the solution of cubic equations. Cardan employed toward him all the persuasions in his power to obtain a communication to himself of the famous discovery. "I swear to you on the holy gospels," he promised, "that if you teach me your discoveries I will never publish them, and will, besides, record them for myself in cipher, so that no one shall be able to understand them after my death." Tartaglia, trusting in Cardan's good faith, communicated to him his rules summarized in twenty-seven mnemotechnic verses, in three strophes of nine verses each. Cardan, assisted by his pupil Ferrari, succeeded in extending the rules, solved equations of the fourth degree, and published the whole in the *Ars magna*. Tartaglia, irritated at the algebraist astrologer's violation of his word, fell into a violent rage. He sent to his enemy, according to the fashion of the time, several challenges, and in one of them went so far as to threaten Cardan and his pupil that he would wash their heads together and at the same time, "a thing which no barber in Italy could do." Cardan finally agreed to attend a disputation, which was to be held in a church in Milan on the 10th of August, 1548. He did not appear, but sent his pupil Ferrari. Ferrari bore his part in the contest alone, and the affair would have resulted in favor of Tartaglia if the hostile attitude of Cardan's friends had not caused him to leave Milan by a by-road. "These mathematical jousts," says M. Victorien Sardou, "these challenges proclaimed by heralds and trumpets, with great parade of pompous words and swelling eulogies, were more becoming to charlatans than to really learned men; but charlatanism was then in fashion; a discovery was the finder's secret, and a method of calculating was speculated upon as if it was a new medicinal powder." We do not wholly agree with M. Sardou. We see an example of intellectual activity and find a proof of the importance that was attached to algebraic discoveries in these scientific tournaments in which all classes of society are interested—as formerly, in ancient Greece, they applauded the challenges of poets and the contests of athletes.

Leaving the Italian mathematicians and crossing the Alps, we

find in Paris Pierre de la Ramée (better known by his Latinized name *Ramus*) occupying at the *Collége Saint-Gervais* a chair of Mathematics which he had founded and which was subsequently made illustrious by Roberval. Ramus was born in 1515, at the little village of Cutry, and, a simple domestic at the *Collége de Navarre*, he found time to study all alone. He had the audacity at one-and-twenty years of age to sustain in the open Sorbonne, which swore by Aristotle alone, that all that the Stagyrite philosopher had said was false. Stranger still, "he seems to have convinced his judges, who conferred the degree of Master of Arts upon the bold innovator. Teaching philosophy, he continued to decry Aristotle. The Sorbonne was moved by his course to bring him before a tribunal, which declared him rash, arrogant, and impudent for having presumed to condemn the course and art of logic received by all nations." He was prohibited from writing and teaching contrary to Aristotle, "under penalty of corporeal punishment." He translated Euclid; and his *Scholæ mathematicæ*, in thirty-one books, was long used as a guide in the teaching of mathematics.

A mathematician of far superior merit to these was Viète, who expounded for the first time some of the most profound and most abstract theories that the human mind has ever invented. Born in 1540, in Poitou, he was appointed in 1580 *maître des requêtes* in Paris. His time was thenceforth divided between the duties of his office and the study of mathematics. He had an extraordinary power of labor. De Thou, his historian, relates that he sometimes spent three days in his study, taking no more food and rest than were absolutely necessary, and not leaving his chair or desk for them. He was commissioned by Henri IV to decipher some dispatches which the court of Madrid had sent to the Governor of the Low Countries. He acquitted himself very well of this difficult task—so well, indeed, that the Spaniards accused him of sorcery. He also solved in a few moments and in the presence of Henri IV a problem that had been proposed by Adrien Romain to all the mathematicians in the world. It was a problem extemporized as a diversion—an equation in the forty-fifth degree. The great analyst demonstrated that the equation depended upon the division of an arc into forty-five parts. He was the one who first in equations represented all the quantities by letters, with which all operations were performed which it had been usual to perform with numbers.

Viète published trigonometrical tables, in which he enunciated for the first time the law according to which the series of multiple or submultiple arcs increase. An enumeration of all his labors would require more space than we can spare. By his learned labors of analysis this man, the creator of mod-

ern algebra, prepared the way in which were to follow with giant steps, making themselves illustrious, Descartes, Fermat, Pascal, and finally Newton.—*Translated for The Popular Science Monthly from La Nature.*

BIRDS' JUDGMENTS OF MEN.

By M. CUNISSET-CARNOT.

WE put animals under all sorts of contributions, taking even their lives for our necessities, pleasure, and caprice, without once considering what their views may be of our proceedings or of us, or whether they have any views. We need not doubt that they have views, and some very definite ones. Mute witnesses of our lives, they examine, observe, and judge us; and some judge with a marvelous accuracy.

Birds, in particular, are all the time fluttering around us; they witness all our motions, interpret all our gestures, and very quickly form a perfectly just opinion of our character. The selection exercised by swallows has been remarked—they are said never to build their nests, except in quiet houses—and the prudence of the crow, which readily marks the difference between a harmless pedestrian and a hunter, and always keeps itself out of reach of the sportsman's gun, is well recognized. The accuracy of the observation of birds goes beyond this ordinary sagacity, and I am convinced that those birds which reside near man utilize for their advantage, security, or pleasure a multitude of very complete, fine, and judicious remarks which they make concerning their dangerous neighbor. I will tell here of two recent examples as a contribution to the study of the pyschology of birds.

The house I live in is situated in a faubourg of Dijon, in the midst of a garden surrounded by other gardens. The quarter is a chosen haunt of birds—nightingales, warblers, tomtits, finches, redthroats, wrens, etc., are abundant, besides the innumerable and undisciplinable army of sparrows. All the people of the house profess for the inhabitants of the garden feelings of the highest sympathy, which are manifested in numerous good ways by bathing-troughs judiciously placed in the shadows of thickets, various seeds put in good places where they will be found, by leaving the nests in absolute solitude, etc. There result such a cordiality and security of relation between our birds and us that the former sometimes manifest a familiarity in our quarters exceeding the limits of good taste.

Some time ago, the weather being pleasant, although it was as yet but little after six o'clock in the morning, I was working with

one of the windows of my room open. All at once I heard a sound of wings, and perceived a redthroat, its bill still bordered with the yellow characteristic of infancy, fluttering frightened across the room. It had probably, in its first attempt at flight, met a cat or a squirrel, and had taken refuge with me under the stress of a panic-stricken terror. It was so frightened that, in trying to get out, it did not see the open window, and beat obstinately against the glass of those which were shut. I thought it best not to interfere, lest I might frighten it still more; hoping, besides, that it would be more perspicacious when it had recovered its self-possession. It soon desisted from its attempts and perched itself on a corner of my bookcase. I watched it with the corners of my eyes without moving; I observed that its respiration gradually became more regular, and its expression resumed its calm. It completely recovered itself in a few moments, but, instead of trying to escape, it stayed where it was, uttering frequent light cries. In response to these calls, another redthroat came in, adult and experienced, evidently the father of our frightened one. He flew rapidly round in my room, like one examining the resources and means of the country; then, having beaten his wings for a few seconds before his offspring to encourage him to follow him, I fancied, he went out alone with a jerk of his wings, without missing the window. Here, I thought, is a father who takes things philosophically; sure that his chick will be in no danger, he plants it there and goes back to his business. But I judged too hastily. In less than a minute the father came back, bringing a caterpillar in his bill; he gave it to the little one, then went out, returned, and made twenty journeys for provisions, bringing in all sorts of insects, to the great satisfaction of the young one, which became quite contented and made itself well at home, erecting its feathers, smoothing them, working itself into a ball, and peeping. But its skill did not correspond with its appetite: it dropped the insects on my books, not to my pleasure; then there came a spider of respectable size, when, having a horror of spiders as unreasonable as unconquerable, and disliking the litter left by the little bird on my books, I thought it was time to give these creatures to understand that their familiarity was a little in excess of the limits. I opened all the windows, and, shaking my handkerchief, sent them to continue their feast in the woods.

Among our birds are a pair of redstarts which faithfully return to us every April. We are old acquaintances, and a degree of confidence is established between us above anything that can be imagined. These birds habitually make their nests, within reach of the hand, in a large ivy that grows on the wall near the garden gate. Whether this situation had ceased to please them, or some accident had happened to a first nest that we did not see,

they this year set up their household in a new spot, selecting the letter-box. One of the boards of the frame of the box having become detached, an opening was made in it large enough to allow them to pass back and forth. This box is fixed to a little foot-gate connected with the large wagon-gate, which is opened and shut more than a hundred times a day; about twenty inches above it is a bell that sounds loudly enough to be heard within the house, two hundred and fifty feet distant, which is rung every time the little gate is opened. I should say that, as soon as I saw my birds take the box for their house, I asked the postman to put nothing more in it; but when I perceived that the nest was in building, it was nearly done, and the letter-box had been used as such for nearly two days without the birds being troubled by it; and I should add that during those two days the box was emptied by a groom too small to see to the bottom of it, and the nest being in a corner, he had not seen or disturbed it. There are now four eggs in the nest, and the birds have begun to sit upon it.

It is therefore evident that these redstarts as well as the redthroats had formed a correct idea of the kindliness of their host, that it had taken deep root in their little brains, and that the confidence they showed in us was the result of very attentive, precise, and just observations which they had been able to make upon the inhabitants of my house.—*Translated for The Popular Science Monthly from La Nature.*

SKETCH OF JOHN ERICSSON.

THE arts of marine engineering and naval construction have been revolutionized through the inventions of Captain Ericsson. As is remarked in a passage cited by Mr. F. C. Church, in his biography of him, "in the closing years of his life he could look back upon 'a change in the physical relations of man to the planet on which he dwells, greater than any which can be distinctly measured in any known period of historic time,' and this he had no small part in creating."

JOHN ERICSSON was born at Langbanshyttan, in the province of Wermland, Sweden, July 31, 1803, and died in the city of New York, March 8, 1889. His ancestry is traced back to the family of Leif Ericsson, the son of Eric the Red, the Norse discoverer of America. He was also related to Thorwaldsen, the sculptor, who was descended, according to Mr. John Fiske, from the son of Thorfinn Karlsefne, the first white child born on American soil. His father, Olaf Ericsson, was a proprietor of mines; his mother was a daughter of an ironmaster, who was possessed of gifts which,

according to Mr. Church, she transmitted to her sons Nils and John. She used to relate that an old man had prophesied to her father that two boys would be born in the family who would become famous. John manifested ar aptitude for constructive work at an early age. As a child he amused himself with drawing, boring, and cutting. A little older, he watched the engines at the mines, copied their models in his drawings, and studied their motions. He traced the first suggestion of his future career to the day when, in his seventh year, he dug a mine a foot deep and made a ladder for the use of imaginary miners. When nine years old he had learned the use of drawing instruments and the art of preparing constructive plans.

In the industrial disturbances occasioned by the war with Russia Ericsson's father lost all his property and was thrown out of business. In 1811 he obtained a responsible position in connection with the construction of the Götha Canal, in which he gradually rose. John in the meantime was improving in the exercise of his rare talents. In the deep forests, to which his father had removed, drawing tools were hard to get. He had a pen and pencil. He made compasses of wood, with needles for the points; contrived a drawing pen out of a pair of tweezers; and made brushes of the hairs of his mother's sable cloak. With these home-made instruments he executed the drawings for a pumping engine to be operated by a windmill.

The best use was made for the Ericsson boys of the limited educational advantages which the region afforded. A governess was furnished them in the years 1811 and 1812. A draughtsman, connected with the work on the canal, taught them how to finish their drawings in a style which rivaled that of engraving. They were given access to the draughtsman's office of the canal company. John exhibited his first drawing to the scale when eight years old, and he learned to sketch maps. One of the superintending constructors of the canal was engaged to teach the boys algebra and architectural drawing. Another tutor "plagued them with lessons in Latin grammar," from whom also John learned "chemistry and many other things," he says, "of great use to me; for instance, how to make and mix colors for my drawings out of materials bought at the druggists for a few cents." The curate at Fredsberg on the Lefsäng was engaged to teach them French. The most distinguished mechanical draughtsman in the country gave them further perfection in his art; and other instructors, drawn also from the professional men engaged on the canal, taught them algebra, field drawing, geometry, and English. While John was naturally disposed to think and act for himself, these lessons tended to promote and encourage his intellectual self-reliance. When a friend spoke to him

with regret of his not having been graduated from some technological institute, he answered that the fact, on the other hand, was very fortunate. If he had taken a course at such an institution, he would have acquired such a belief in authorities that he would never have been able to develop originality and make his own way in physics and mechanics.

When John was eleven years old he and his brother became pupils in engineering of Captain Edström, who had been sent to England to study the most approved methods in canal construction. He was so pleased with their work that he recommended them to Count Platen, President of the Götha Ship Canal. This officer had been shown specimens of what John had done, and, receiving him, predicted that if he continued as he had begun, he would some day produce something extraordinary. When twelve years old John was employed, under the direction of his chief, in drawing profile maps and plans for use on the canal, and to be filed in the archives of the company; in the next year he was assistant to the *niveleur* (or leveler) in charge of the station of Riddarhagen; and in another year, when only fourteen years old, and obliged to stand on a stool to reach the eyepiece of his surveyor's level, he was put in charge of the Rottkilms station, where he had to give directions daily to six hundred men. About this time he became assistant to the chief of the work. While engaged as leveler he made drawings of the Sunderland iron bridge, which Count Platen admired very much. He drew for his private use maps and sketches of important parts of the canal and of the machinery used in its construction, which he began to publish several years afterward, inventing an engraving machine to enable the work to be more speedily done. He found, however, that the machinery illustrated by his drawings was being superseded in the rapid progress of improvement in mechanical construction, and discontinued this enterprise.

In 1820, when Ericsson was seventeen years old, after his father had died, he entered the military service of Sweden, and was appointed an ensign in the Royal Field Chasseurs of Jämtland, and stationed at Frösön, near Ostersund. The step was taken against the protest of Count Platen, and was the occasion of a breach between them. Soon after joining his regiment he was recommended for promotion, but his colonel was out of favor at court, and the recommendation would not have been heeded, had not the Duke of Upland, son of King Bernadotte, pleaded for him. The duke showed his Majesty one of Ericsson's military maps, whereby the promotion was secured, and the king's attention was directed to Ericsson's skill as an engineer. Ericsson was subsequently commissioned to draw maps to illustrate the campaigns of Bernadotte as marshal of Napoleon. He passed the

examination for and obtained an appointment on the survey of northern Sweden, and in connection with that work made detailed drawings of fifty square miles of the country.

On the advice of friends, including the king, who considered his abilities greater than could be adequately rewarded in Sweden, and himself, no doubt, willing to seek a larger field of usefulness, Ericsson in 1826 secured a leave of absence from the service and went to England. He took with him plans, including a flame engine which he had experimented on successfully with wood as fuel, but which was not available when coal was used; and a still undeveloped idea in his mind of a vessel which "it was possible for Sweden to build, and which would render the wooden walls of England of no avail against her." He had intended to resign his lieutenancy, but, overstaying his leave of absence without obtaining an acceptance of his resignation, he was placed in an embarrassing position, from which he was extricated by the intercession of the crown prince; and in October, 1827, he received a promotion to a captaincy and an acceptance of his resignation. The title of captain thus obtained, and a degree of LL. D. from an American university, were the only honors he cared to display to the public, though he had many others equally high.

In the two years, 1828 and 1829, after he went to England, Captain Ericsson completed seven inventions. One of these, a machine for compressing air, was used in clearing one of the Cornish mines of water; another involved the use of artificial draft for steam-boiler furnaces. Sir John Ross was preparing for his second arctic expedition, but not wishing his purpose known, concealed it in ordering the engines of his vessel; and the contractors, Braithwaite and Ericsson, supposing that the voyage was to be of an ordinary character, put in one of these engines with other appendages not adapted to arctic navigation. When Captain Ericsson learned the destination of the vessel, he warned Captain Ross that the engine had not been built for that kind of work and would be useless. His prediction was fulfilled as soon as the vessel entered arctic waters, and the engine was thrown overboard. The principle was, however, retained for ordinary steam vessels, with results quite satisfactory. The third invention was a steam fire engine. The first, an experimental engine, was followed by four others, completed, one of which, sent to Prussia, proved so efficient that the designer received, in recognition of its value, an honorary membership in the Berlin Institute. Another engine, employed in London, extinguished the fires, but was objected to and rejected on account of the quantity of water it required; and it was nearly thirty years before London would have another steam fire engine, inferior to Ericsson's.

In 1829, while it was still undecided whether stationary or

locomotive traction should be adopted for the railway between Liverpool and Manchester, a prize of £500 was offered for the best locomotive. Although five months were given the competitors in which to prepare themselves, Ericsson did not learn of the offer till within seven weeks of the day of trial. Stephenson brought out his "Rocket" engine, with every appointment perfect and tested. Ericsson produced his "Novelty," graceful in design and structure, and with every part planned on sound principles, but built in haste and untested. It suffered two breakdowns in the trial, caused by undetected faults in workmanship; but not before it had passed the "Rocket" and reached a speed of thirty-two miles an hour. Ericsson withdrew it in disgust, and the prize went to Stephenson. But every one admired the beauty of the "Novelty"; the judges spoke of its appearance as being very much in its favor, and commended the ingenuity with which the machinery was so contrived as to work out of sight, and the compactness of its form; and John Scott Russell, the eminent English engineer, wrote in the Encyclopædia Britannica in 1840 that "the 'Novelty' had to be withdrawn through a series of unfortunate accidents which had no reference to the character or capabilities of the engine. And we well recollect that it made a profound impression on the public mind at the time. On the first day of the trial it went twenty-eight miles an hour (without any attached load), and did one mile in seven seconds under two minutes." Two other elegant locomotives were built by Ericsson, but they failed to give entire satisfaction in the working, and this field of construction was left to Stephenson.

In 1830 Captain Ericsson devised the centrifugal fan blower which afterward came into general use on our river steamers; in 1834 he took out a patent for a deep-sea lead, on a principle similar to the one employed in a lead designed by Sir William Thomson. He received a prize from the London Society of Arts for a hydrostatic weighing machine. He exhibited at the International Exhibition of 1852, and received a medal for them, an instrument to measure distances at sea; an alarm barometer which sounded a gong in warning of approaching storms; and a pyrometer which measured temperatures up to the boiling point of iron. He invented an instrument for measuring the compressibility of water; methods of propelling boats on canals, one of which has been applied to the heavy grades of Swiss mountain railroads; a water meter, a centrifugal pump, a file cutting machine, an apparatus for making salt from brine, and numerous applications to the steam engine, many of which came into use, while others were abandoned. He experimented with superheated steam; and Mr. Church says that he designed more than five hundred steam engines.

While he was making all these machines he was also experimenting with designs for a caloric engine. His researches in this direction were begun with the "flame engine" already mentioned. He contributed a paper on the subject to the English Institution of Civil Engineers in 1826; built three engines in 1827 based on the principle of the expansion of air; brought out a completed caloric engine in 1833, to which he applied improvements as his investigations continued; received the Rumford medal in 1856 for his researches into the nature of heat; and, according to Mr. Church, spent in thirty years, including the engines for his caloric ship, more than a quarter of a million dollars in building twenty-seven experimental engines. The caloric system was not successful when applied to the propulsion of large vessels like the Ericsson, although that vessel registered a speed of eight and attained at one time a speed of eleven miles an hour, but for lighter work it has proved very practicable and efficient; the smaller machines have been extensively used, and the inventor derived large profits from them.

The first experiment with the screw propeller was made in 1836 by Captain Ericsson, in conjunction with his friend Francis B. Ogden, of New Jersey, United States consul at Liverpool. A model of the apparatus was built and tested in a public bath. Then a boat forty feet long, propelled by a double screw, attained a speed of ten miles an hour on the Thames. The Lords of the Admiralty were passengers on the trial trip; but seeing was not believing with them, and, while they witnessed the successful performance of the craft, they declared that no vessel could be steered if the power was applied at the stern, and would have nothing to do with it. Captain Robert J. Stockton, of New Jersey, afterward United States Senator, was visiting England at the time on business connected with the Delaware and Raritan Canal, and, witnessing the performance of the propeller vessel, ordered one built for himself and named after him. It was sent across the Atlantic, and when it reached New York the freedom of the city was given to its captain. This vessel was employed for many years in the waters of the United States, and, passing into the possession of the Messrs. Stevens, of Hoboken, N. J., was known as the tug New Jersey till 1866, when, or about that time, it was broken up.

On the invitation of Captain Stockton, Captain Ericsson resigned, in 1839, the position of Superintending Engineer of the Eastern Counties Railroad in England, and removed to the United States. By the aid of Captain Stockton's influence he obtained a commission to build a steam-propeller frigate, the Princeton, for the United States Navy. Before this vessel was finished, in 1844, his screw had been placed in forty-one commercial vessels of the

United States. Another new and valuable principle was introduced in the Princeton—that of applying the power directly to the shaft turning the screw. Ericsson's propellers with direct-acting engines below the water line were also applied in the French frigate Pomona in 1843, and in the British frigate Amphion in 1844. The Princeton was fitted with a twelve-inch wrought-iron gun, forged after Ericsson's designs, and strengthened with bands, which had been tested; and with a heavier gun ordered by Captain Stockton, called the Peacemaker. This gun, when fired—Ericsson's friends claim, against his advice—during a visit of President Tyler and members of his Cabinet to the Princeton, February 28, 1844, burst, killing the Secretaries of State and the Navy, and Colonel Gardiner, of New York.

From the year 1826 Ericsson had entertained the idea of contriving an "impregnable and partially submerged instrument for destroying ships of war," and had a plan matured for it in 1835; and the idea of protecting war engines for naval purposes was as old with him, he wrote, as his recollection. He had become satisfied also that armor plates that a vessel could carry could not be forged which a gun could not be constructed to penetrate if fired directly at them. From these ideas was developed the plan of the submerged vessel carrying a turret, which was embodied in the Monitor. In August, 1861, he proposed to President Lincoln to build a vessel for the destruction of the Confederate war-craft, declaring that his purpose was not private profit but only to serve his country. No settled purpose or idea of what was to be done seems to have existed in Washington; but Ericsson, after presenting his plans, was directed to construct the Monitor according to them, within a hundred days. The result of the first experiment with this vessel constitutes one of the sensational incidents of history. The Monitor's guns were not allowed to be charged in that action as heavily as Ericsson desired—they would have borne, in fact, a charge three times as great as was given them—consequently the Merrimac was not destroyed, as it probably might have been. Nine other monitors were built for the Government by Ericsson and his business associates, of which the Dictator was completed, as he reported to the Navy Department, with a displacement of a fraction of an inch less than he had calculated.

In 1869 Captain Ericsson contracted to furnish the Spanish Government with thirty gunboats after his own designs, for use against Cuban insurgent blockade-runners. They were all afloat within four months, two months before the time they were to be called for by the contract, and half of them had their engines and boilers on board. Several novel features were introduced upon them; they proved admirably adapted to their purpose; and in

recognition of his service the Spanish Government conferred upon Ericsson the decoration of Isabel la Católica.

Captain Ericsson's ideas of a war vessel for submarine work more seaworthy than the monitors were embodied in the Destroyer, which was launched in 1878. "It is an iron vessel, one hundred and thirty feet long, seventeen feet wide, and eleven feet deep, protected by a wrought-iron breastwork of great strength near the bow," carrying a submarine sixteen-inch gun thirty feet long, the muzzle of which projects through an opening in the stem near the bottom, and which is intended to carry a fifteen-hundred-pound projectile charged with three hundred pounds of guncotton. The vessel is intended to attack "bow on," and to discharge its projectile from within three hundred feet of the object of assault. The bill for the purchase of this vessel by the United States, although it passed the Senate in 1885, failed to become a law.

"Three distinct purposes," says Mr. Church, "are apparent in Ericsson's labors: first, to improve the steam engine and extend the scope of its application; next to discover some more economical and efficient method for changing the mode of motion we call heat into the mode of motion we call power; third, to force the great maritime nations to declare the ocean neutral ground, by making naval warfare too destructive a pastime to be indulged in." We have seen how he worked out the first of these ideas in his numerous adaptations of the steam engine, and the third in the monitors and the Destroyer. In trying to make the second idea practical he devised the caloric engine and devoted many of the later years of his life to the investigation of the solar heat and of methods of converting it into a direct source of mechanical power. He devised and constructed a solar engine in 1883, which was described and illustrated in Nature (Vol. XXIX, p. 217), and labored until within two years of his death to improve and perfect it. In his description of this engine he showed that with reflecting plates of one hundred and thirty by one hundred and eighty inches and a steam cylinder of six by eight inches he could obtain a speed of engine of one hundred and twenty turns per minute, with an absolute pressure on the working piston of thirty-five pounds per square inch. He devoted himself regularly and, except for the daily walk for his health, unremittingly to his work. Fitting up his office and workshop in Beach Street, New York, he occupied his whole time in investigation, experiment, and construction, refusing to be interrupted, and shutting himself out from general visitors. He was a man of great physical strength, and some remarkable stories are told of his feats in lifting. In one of them, when in youth he raised a weight of six hundred pounds, he thought he overstrained himself, and

he ascribed to it certain pains in his back from which he suffered.

He participated eagerly in physical sports, was expert in Swedish gymnastics, was one of the best shots, the best leaper, and the champion wrestler in his regiment, and was famed as an athlete, skater, and swimmer. Mr. E. H. Stoughton, formerly minister to Russia, is said to have surprised him once at sixty years of age standing on his head, to prove that he had not lost his agility. He was a man of unbounded benevolence, and never refused the petitions of those who came to him in need.

While his literary works were not numerous, Captain Ericsson was a writer of force and ability, with imaginative faculties that might have been developed under cultivation. In his youth, and while engaged in his surveying work, he sometimes, he says, "wrote poetry to the wonderful and enchanting midnight light of Norrland. Connoisseurs often doubted that it came from the second lieutenant and surveyor among the mountains." His communications to the periodical press on the subjects in which he was interested were clear and vigorous, and always acceptable.

He was a man of intense patriotism, which he manifested equally toward his native land, although he never returned to it, and the United States, the country of his adoption. In his studies and inventions he had always in view the protection of Sweden against the aggressive stronger powers; and he gave the fruits of them ungrudgingly to the United States—not always insisting upon his reward as persistently as he had a right to do, and too often not receiving it, or receiving it at the expense of delay and trouble not creditable to our Government. His gifts to Sweden, after he became prosperous, were numerous and bountiful, and included contributions for the relief of sufferers from famine and from a fire at Carlstad, and for a benevolent fund for the aged miners and miners' widows of his native province; a subscription to the Royal Library of Stockholm; the guns for the first Swedish monitor; and a gunboat for coast defense. In 1867 the miners of his native region erected in front of the house in which he was born, at their own expense, a large granite monument, bearing the inscription, in Swedish, "John Ericsson was born here in 1803."

We are very largely indebted for the detail of the facts concerning Captain Ericsson's inventions to the excellent biographical articles concerning him by Mr. William C. Church, which were published in Scribner's Magazine in 1890.

EDITOR'S TABLE.

THE BEARING OF THE DOCTRINE OF EVOLUTION ON SOCIAL PROBLEMS.

THE following very pertinent questions were proposed for discussion at the World's Congress of Evolutionists, held during the last days of September in connection with the Columbian Exposition:

"Does the doctrine of evolution in its sociological aspects offer wise suggestion for the solution of the grave social and economic problems of our time?

"What in accordance with such suggestion should be the next step taken in our own country looking toward the solution of these problems?"

At the moment of writing we are not in possession of the result of the discussion thus provoked; but, as the questions must be of interest to very many of our readers, we propose to attempt such an answer to them as our brief limits permit.

The doctrine of evolution in its broadest aspect is simply that doctrine which teaches us that everywhere throughout Nature there are action and reaction between organisms and their environments; that where the result of this action and reaction is increasing heterogeneity and complexity of the organism, with more complete and various adjustment or adaptation to the environment, a process which may be called evolution is in progress; and that when, on the other hand, the result is the obliteration of special adaptations and combinations and a return toward simpler modes of organization, a process of dissolution is in progress. It is a doctrine which proclaims the supremacy of natural law, and which keeps prominently before the mind the necessity of an efficient cause for every change that takes place. It thus introduces into the realm of organic Nature and into the moral and social spheres the Newtonian principle that the direction of motion can not be changed without the application of force. The mind that has accepted the evolutionary view of things has done with vain superstitions and idle credulity. It feels no less than before the vastness and mystery that surround human life and limit human thought, but it has lost all appetite for what may be called the vulgar marvelous—that toward which childish minds of every age go so eagerly forth.

When, therefore, we try to bring the doctrine of evolution to bear on the social and economic problems of our time, the first thought that occurs to us is that the so-called problems are aspects of the change that society is undergoing in its progress toward higher organization. That the process in the midst of which we live is one of evolution and not of dissolution is evident by many signs. What we see is the effort of the different classes and elements of society to achieve the establishment of satisfactory mutual relations, or, as we may otherwise express it, to discover and give effect to a *modus vivendi*. That this involves occasional conflict is just what might, on general grounds, have been anticipated. The market price is not fixed without a good deal of "higgling," and precisely the same process applies to the adjustment of social relations. "Higgling" may not be a beautiful thing to witness, but it does its work in the fixing of prices much better than would a competition in altruism, which could only lead to utter confusion. The evolution philosophy would therefore suggest to us extreme caution in interfering at all with the process which we see at work. What is manifestly necessary, however, is that no one individual or group of individuals should be al-

lowed to exercise arbitrary and irresponsible power in the effort to advance their claims. Power, in the last resort, belongs to the community as a whole, and no man or group of men should be encouraged for one moment to think that he or they can be allowed to usurp the authority of society. There is no "higgling" if one of the parties to the bargain takes a club and forces the other to accept his price. Society should be the sole club-wielder, and, while slow to wield it in general, should be quick to wield it upon those who would take the club out of its hands. It is bad for the individual not to insist upon his rights; but for society not to insist on its rights is absolutely fatal.

In the popular mind the theory of natural selection is largely identified with the doctrine of evolution, and many are impressed by the work of Darwin who have but a scant knowledge or appreciation of that of Spencer. Darwin was buried in Westminster Abbey, but whether an equal honor awaits the author of the Synthetic Philosophy is perhaps doubtful. The theory of natural selection, however, far from being the whole of evolution, is only a subordinate aspect of it. At the same time, if we would gather the practical lessons of the evolution philosophy, the views elaborated by Darwin claim our serious attention. We have learned from him how Nature is continually *selecting* those who are to carry on the great chain of life. Not every one who is called is chosen, which, interpreted by Darwin, means that not every one who is called *into* life is chosen to carry on life. Far from this, the vast multitude of living things meet untimely death, and go to aid, either actively or passively—actively if they minister to their sustentation, passively if by their absence they lessen the demand on food supplies—the lives of the survivors. There is perhaps no greater or more serious problem confronting society today than this: how to pay just heed to the above law without injury to our own moral sensibilities and particularly to our sense of the sacredness of life. It is impossible to doubt that the law on which the well-being of every other animal species depends must be vindicated in the case of the human species also; and yet the very fact that we are sensible of the problem before us shows that we are called to solve it in a manner suitable to our higher intellectual and moral development. As every one is aware, there is at present an important controversy in progress between Mr. Spencer on the one hand and Prof. Weismann on the other, upon the question as to whether modifications acquired by an organism during the course of its individual existence are transmissible by inheritance. The discussion is not one into which we can enter; and we only refer to it for the purpose of remarking that, though it seems to touch a vital point in the doctrine of evolution, the great fact of evolution remains unassailable. The practical difference between one view and the other is that, if Mr. Spencer is right, a larger scope seems to be opened for educative effort, and more encouragement for such effort is afforded; whereas, if Prof. Weismann is right, the one all-important principle to keep in view, if we would preserve society from degeneration, is that of selection of stocks, seeing that an inferior individual, however much we may improve him personally by education, must, if he have progeny, transmit, not the qualities imparted by education, but those bestowed upon him by Nature at birth.

The doctrine of evolution thus shows us the necessity for struggle in the settlement of the bases of society, and it indicates, in a general way, how that struggle should be carried on, namely, by a firm and decent assertion of individual rights, and the acceptance by each and all from time to time of such compromises as circumstances prescribe. Should there be, in any given society,

such a relaxation of the moral fiber of individuals as would lead them to forego their just claims, in presence of violent demands unsupported by reason, there would be great cause to fear that the society as a whole would also abnegate its just authority and thus leave the way open for lawless, ambitious, and anarchic forces. If not the greatest, the surest service, therefore, which any individual can render to the community in which he lives is to stand on his rights, not in his own interest or for his own sake merely, but in the interest and for the sake of all his fellow-citizens; for in this way others will be encouraged to stand on their rights, unjust pretensions will be discouraged, and the whole fabric of society strengthened. We say this is the surest service an individual can render; because there is no doubt whatever as to the beneficial results of such a line of conduct, whereas all purely altruistic measures are of more or less uncertain tendency. This is shown by the frequent failure of benefactions to accomplish the purposes for which they were intended, or, we may even say, their frequent perversion to purposes entirely opposed to the objects in view. It requires a vast amount of wisdom to be generous without doing more harm than good; but, in practicing and insisting on justice, no risk whatever of doing harm is incurred.

If there is any one thing in the way of positive effort which the doctrine of evolution seems clearly to prescribe as advantageous, it is the exposition of the doctrine itself to all who are capable of understanding it, so that there may be a general comprehension of the true goal of society and of the conditions necessary for unimpeded social progress. How few persons, comparatively speaking, understand that justice is the one vital principle, the one essential condition of social welfare! How few persons are prepared to make allowances for the necessary imperfections of human society, or to see in what is commonly regarded as evil a preparation for higher good! How few have the balance of mind that enables them to place a true value on the nostrums of would-be reformers, who undertake to make you a new society if you will only allow them to pass a law or two! How few have a true and reasoned faith in the possibilities of social progress! In regard to all these matters there would be a great increase of public intelligence if the doctrine of evolution, with all that it implies, were as earnestly and industriously taught as certain other views of life, which appeal more to emotion than to reason. The doctrine of evolution stands to-day for the scientific view of life, and, the more that view can be brought home to the masses, the surer will be the foundations of the state, and the more rapidly and happily will the stages that yet separate us from a condition of perfect social health be accomplished.

SCIENCE AT THE COLUMBIAN EXPOSITION.

The great Fair at Chicago marks the utmost achievement of the kind that the world has beheld, and probably the last effort which America will see on the plan of universal inclusion. Science and art in these latter days have become so broad in development, so minute in specialization, that from sheer unwieldiness it would be scarcely possible to repeat the programme of Chicago, expanded as it inevitably would be in the flight of time. In Great Britain the universal exhibition has been differenced into a series of expositions of fisheries, inventions, "healtheries," and so on, a sensible plan which America is likely to copy. In displays so vast as those of Jackson Park the ordinary visitor can bestow no more than a passing glance on rows upon rows of cases, often filled with objects of beauty and high interest. Those who have been instructed by the Fair are those who went to study a particular feature of it, or the

fortunate few who have been able to devote months to its examination as a whole. And yet something will be lost when the days of universal exhibitions are past. There is a cross-fertilization of ingenuity illustrated only when displays of the utmost diversity are brought together. In Machinery Hall is the familiar festoon of perforated cards guiding the Jacquard loom; in the Federal Building is a new indexer for libraries identical in principle; in the Transportation Building is an extensive array of the maps whose marginal letters and figures indicate the particular square in a chess-board where a sought town or village may be found; in Machinery Hall the compositor is superseded by a machine which adopts the same principle in casting type from a manuscript reduced to perforated symbols.

In so far as there may be a science and an art in disposing a universal exhibition the Fair at Chicago evinces a distinct advance. Mr. G. Brown Goode, of the National Museum at Washington, defines an efficient educational museum as a collection of instructive labels, each illustrated by a well-selected specimen. Add to this the intelligent custodian to answer inquiry or to show a machine or an apparatus at work, and from museums are born an exhibition interesting and informing. Something else, however, is necessary—an exhibition must mainly, but should never wholly, depend upon the good will, the enterprise, or the generosity of individual exhibitors. Wherever needful, it should be made comprehensive by the board of management buying or hiring what they can not borrow. Because of the strike at Homestead last year there is at Chicago no adequate display of the iron and steel industry which has in America made so remarkable progress within recent years. In the Electricity Building there is no display of Edison's kinetograph, an instrument which nearly two years ago had been brought to the point of reproducing by instantaneous photography with remarkable fidelity the visual impressions of motion.

With abundant means, with trained skill and comprehensive purpose, much the best group of exhibits at Chicago is presented by the national departments, in the Federal Building. Within its appointed limits the displays in the Anthropological Building are as admirable in arrangement as those of the Federal Government; here the debt is mainly due to the devoted labors of the officer in charge, Prof. F. W. Putnam, of Harvard University. In the Agricultural Building the State experiment stations, which owe their origin to Prof. W. O. Atwater, in their systematic array of appliances and results show how much the farmer is profited by his new partnership with the man of research. Agriculture, it would seem, in certainty of results, is fast taking on the conditions of manufacture. Many of the industrial exhibits in excellence of arrangement vie with those formally scientific; as a type of these displays that of the Standard Oil Company deserves particular mention. In the same building, that of mining industry, the western gallery bears a small but capital exhibit of aluminium, from its ore, bauxite, through the processes of the electrical furnace until pure metal is derived: all the principal uses of the metal are illustrated; these are accompanied by specimens of its most valuable alloys. This exhibit is in striking contrast to others within the same walls—displays some of them as ill assorted as the contents of an auction room.

In designing several of the State buildings at the Fair they were contrived to pay a double debt: they illustrate noteworthy styles of architecture, or reproduce famous structures, as well as serve as show places and club houses. In much the same way it would have been easy for, let us say, the Shoe and Leather Building to have exemplified the slow-burning construction for factories which in the Eastern States has so much reduced the fire tax.

These are not times when inventors or manufacturers wait for an exhibition to give the world its first view of their work; hence, in the Electricity Building, for example, there is little of novelty, and yet in its mass and variety the contents of the great hall and galleries are most impressive. Here are shown how, in the seventeen years since the Centennial Exhibition, electricity has passed from the experimental laboratory to become the most versatile and powerful servant that industry and domestic economy know.

Within the past two decades Photography has stridden along almost as fast as her sister Electricity. In an inconspicuous booth in the gallery of Liberal Arts is an exhibit without an attendant, lacking adequate labels, and yet withal marking an epoch in the application of scientific research to this art and industry. The display presents photography in colors, an achievement due to Dr. H. Vogel, of Berlin. In observing the fugitiveness of some aniline dyes, it struck him that the very sensitiveness to certain rays of the spectrum which rendered the dyes as such worthless, meant a photographic quality of the first importance. Experiment proved the soundness of his surmise, and orthochromatic and color photography were born. In pure and applied chemistry Germany, as her show-cases at Chicago amply attest, is far in the lead. In Germany practice and theory have long ceased to look askance at each other, and the lesson should not be lost on America, for theory and practice have at last arched toward each other until at many points they touch, with the effect that both are vastly the stronger. To-day the observer can pass to prediction, the experimenter can build to order a molecule, a flower, a cereal, or a beeve. The convincing word of Germany to America is that to begrudge the means for original research is simply to withhold the seed-corn of progress. But America, too, has something to teach. In science her most worthy and characteristic display is that of instruments of precision. The dividing engine of Prof. W. A. Rogers, the diffraction gratings of Prof. H. A. Rowland, the parallel planes in glass of Mr. J. A. Brashear—with a limiting error of one millionth—the lenses with perfect color correction of Prof. C. S. Hastings, mark a distinctively American field of attainment and make clear why this country divides with France the leadership in modern astronomy, and in apparatus for the most refined measurement has no rival. It is gratifying to see at the Fair the magnificent new telescope for the University of Chicago, the refractor for which, forty inches in diameter, is the largest in existence.

In education the exhibits at the Fair, repetitious though they are and often poor in quality, show progress. The large spaces given up to manual training, to instruction in sewing and cooking, to the all-round development of the senses, abundantly prove that the old and wasteful clerkly instruction has its hat in its hand and is moving toward the door. In the Children's Building the kindergarten and kitchen-garden classes are giving admirable lessons not only to many little people but to uncounted thousands of interested parents. At many other places in Jackson Park how sound education brings out an intelligent interest in every-day work and duty is attractively demonstrated. Take for example the Rumford Kitchen, where with the minimum of toil and offense a meal both palatable and nourishing is cooked at a cost of less than five cents. Mr. Edward Atkinson, who leads in this branch of household economy, is desirous that the State experimental stations should add courses in cooking to their instruction. Why, he argues, should we be anxious that food stuffs be produced with the utmost saving of labor, and then in the cooking waste them one half? For education conceived in its broadest reach one of the

most significant services has been rendered at the Fair by the psychological exhibit and laboratory, over which Prof. Jastrow presides, in the Anthropological Building. Here, amid the most extensive collection of appliances ever brought together in America, quantitative tests of faculty are made: the effect of this new science of experimental psychology on education must be to sift out good methods of instruction from bad, and in the fullness of time to awaken and direct in the individual mind the ambitions which to-day either remain unaroused or ignorantly run riot.

In some respects the most audacious and the least satisfactory part of the programme at Chicago has been the Auxiliary Congresses. Assembled seven miles from Jackson Park, in a building directly abutting on a noisy railroad, filled with smoky and dusty air from locomotives and factory chimneys, the sessions have often been too much for human endurance. With utterly inadequate means the president, Hon. C. C. Bonney, has been unable to provide fitting attendance, or to give suitable publicity to the daily proceedings. Nevertheless, despite shortcomings on every hand, the Art Institute has during the past five months given a hearing to nearly every eminent American teacher, and it has opened its doors to Prof. von Helmholtz, and to other men of science from abroad scarcely less illustrious.

LITERARY NOTICES.

SEVENTH ANNUAL REPORT OF THE COMMISSIONER OF LABOR, 1891. CARROLL D. WRIGHT, Commissioner. Washington: Government Printing Office. Pp. 841.

IT is the duty of the Department of Labor to provide for reports, at intervals of not less than two years, on the general condition, so far as production is concerned, of the leading industries of the country. A shorter period is prescribed than that fixed for the taking of the census, in the belief that a fairer average would be shown in the run of consecutive reports of short terms than could be obtained from reports made every ten years, any two or more of which might be, relatively to the intervening years, exceptional ones. Two years from the organization of the department, however, brought it to the census year 1890, when its report would be merged in or superseded by the census returns; so that it was not deemed expedient to establish the system of reports contemplated till 1892. A method has accordingly been under organization for securing proper information relative to the leading industries of the country which will enable the public to make comparison with the census reports of 1890 as to the movements of production. The department was represented at the Congress on Accidents to Labor held in Berne, and at the Congress of the International Statistical Institute, held at Vienna, in 1891; and it is believed that the experience of American statisticians with reference to labor statistics and the influence of the American representatives prompted the introduction and unanimous adoption of the resolutions of the institute recommending the adoption of similar measures in other countries. The present report, the seventh, continues the investigation of the cost of production in leading countries of articles dutiable in the United States, which was begun in the sixth report and applied in it to iron, steel, bituminous coal, coke, iron ore, and limestone, extending it to the textiles and glass. The facts inquired into include the different elements of cost or approximate cost, the wages paid in the industries involved, the comparative cost of living, the kind of living, etc. All feasible means are used to secure complete information, and, in order that no establishment may be embarrassed by having its inner concerns exposed to the public, the names of all companies and persons who have contributed to the value of the investigation are carefully kept out of sight. The department has aimed to make a judicious selection both as to representative concerns and representative facts; but it does not presume to flatter itself that it has given everything that everybody will want. Two hundred and seventy-eight establishments are represented in the tables, of which forty-nine are

in Europe. The articles reported upon are cotton textiles, cotton yarns, woolen and worsted textiles, woolen and worsted yarns, linen textiles, silk textiles, window glass, green-glass bottles, flint-glass bottles, and lamp chimneys.

THE SHRUBS OF NORTHEASTERN AMERICA. By CHARLES S. NEWHALL. New York: G. P. Putnam's Sons. Pp. 249. Price, $2.50.

THE author has already published The Trees of Northeastern America and The Leaf-collector's Handbook, and is preparing The Vines of Northeastern America—the four constituting a series of work which the botanist, the admirer of native plants, and the possessor of a home to be adorned, can not fail to find useful and acceptable in every way. The purpose is to furnish means by which one strolling in the woods can easily recognize the woody plants he meets, and information concerning their adaptability to planting in the house-grounds; or to introduce the many who have no technical botanical knowledge to the author's "friends, the shrubs." The shrubs described are those which are found native in Canada and the United States east of the Mississippi River and north of the latitude of southern Pennsylvania; and with them, the more important of the introduced and naturalized species. Besides the botanical descriptions—which are clear, easy, and satisfactory—and one hundred and sixteen illustrative plates, there are given a list of families and of genera, directions and a key to the signs used, guides to the shrubs by flower, by leaf, and by fruit, an explanation of terms, a glossary, a list of shrubs worthy of cultivation, and an index to the shrubs.

HOMES IN CITY AND COUNTRY. By RUSSELL STURGIS, JOHN W. ROOT, BRUCE PRICE, DONALD G. MITCHELL, SAMUEL PARSONS, JR., and W. A. LINN. New York: Charles Scribner's Sons. With One Hundred Illustrations. Pp. 214. Price, $2.

THE papers in this volume relating to city homes are partly historical, and treat of the evolution of the plans from the first attempts to adapt room space to narrow lots, to the modern styles. The first one, by Mr. Sturgis, on the City Homes in the East and South, relates to houses in New York, Boston, Philadelphia, Baltimore, Richmond, Va., etc. The views and plans show how the New York house, and still more the Boston house, were cramped by the small size of the lot and the high price of land; while the houses in the more southern cities, Philadelphia, Baltimore, and Richmond, with greater freedom of space, were expanded, and much more convenient and comfortable; and an almost endless variety prevails in the cities farther south. Mr. John W. Root begins his account of the city house in the West by showing how the device of the "balloon frame" has assisted in the spread of settlement and civilization; for almost any one can put up that kind of a house, with the simplest implements, in a short time and at comparatively little cost; and it resists the high winds very well too. The younger Western cities are more than half built of such houses; and they are beneficial to the city's future and to its architecture, for because of them "every old Western city must be almost entirely rebuilt, and this under modern and enlightened auspices, as if it had been devastated by a great fire or cyclone. . . . It certainly presents possibilities to the architects of the West such as have never been given to any other groups of men." On the other hand, the balloon-framed house can never become a landmark, or a link in the architectural development of the country. Western city houses are marked by the absence of blocks like those of the Eastern cities, by the tendency toward greater enlargement and importance of the living and dining rooms at the expense of the parlor and living rooms, and by their openness. The outlook for Western city houses seems to be promising. The architecture is free from the bondage of architectural tradition, and among the various rival cities dominant fads are likely to become less common, and problems will be more generally determined by the nature of the case. In the subject of The Suburban Home, Mr. Bruce Price has a theme on which, regarding the colonial houses, the old country houses, the transitory styles of the later past, the present styles, and their tendencies, he might write well for an almost indefinite length. He satisfies himself with considering chiefly the more meritori-

ous styles of the present. The old colonial houses are considered as in all "the best examples built upon classic lines, with a classic base for all their details and classic feeling in all their outlines," but the author concludes that "in the planning, designing, and building of the moderate-cost suburban villa of to-day the American architect has no equal. His work (that is, his best work) is well above and beyond any period of the school anywhere." A chapter by Donald G. Mitchell on Country Houses follows—a theme which was congenial to the author's taste, and is treated by him as if it were, and is not in disaccord with Mr. Price's Suburban Houses; for while Mr. Mitchell insists the more emphatically that his country house shall be a real home, Mr. Price evidently regards his suburban house in the same light; but Mr. Mitchell's houses are all, or nearly all, old-fashioned and also old. The best treatment of Small Country Places is described by Samuel Parsons, Jr., and the Advantages and Operations of Building and Loan Associations are explained by W. A. Linn.

A Handbook of Invalid Cooking. By Mary A. Boland, Instructor in Cooking in the Johns Hopkins Hospital Training School for Nurses. New York: The Century Company. Pp. 323.

This volume has an attractive aspect, more than a *soupçon* of science, and a flavor of good sense. It is intended to fill a need in the training of nurses for more exact direction in cookery, for some knowledge of the chemistry involved, and for a better comprehension of the precautions necessary to secure healthful food. The first part is devoted to preliminary lessons. These deal with chemical and physical changes, the composition of the body, the general constituents of food, and the important topics air, water, milk, digestion, and nutrition.

In the dissertation on milk, directions are given for testing its acidity, finding its specific gravity, per cent of fat, and methods of sterilization are carefully explained.

In the article on nutrition it is stated that the noblest thoughts and most original ideas do not come from an underfed or dyspeptic individual. This certainly ought to be the case, but the shades of Carlyle, Heine, and a host of their ilk would confront us if we affirmed this to be a matter of fact. If, as the author claims, material substances produced as exact results in the chemical physiology of the body as they do in the laboratory, we should understand many metabolic processes that are now inexplicable. Starch and albumin sometimes remain starch and albumin in spite of all digestive juices to the contrary. When the nerves cry "Halt!" the solvents and acids obey. We recognize this inhibitory action if we follow the suggestion to "serve chocolate in dull red." By pleasing the nerves of sight, we strive to put the body in good nervous condition. It is, however, acknowledged that "it can not be said that any particular kind of food will ultimately produce a poem!"

The second part of the book offers a collection of recipes and *menus* suited to invalids, with special consideration of serving, feeding of children, and district nursing. The recipes are well chosen and, for the most part, clearly given. In the introduction the author complains that the majority of cook-books do not furnish intelligible aid, and it is sad to see that she does not improve upon their example. Three recipes for cake are given, and two of these direct the use of an ingredient whose quantity is not mentioned in the formula. In addition to this, it is doubtful whether unfledged cooks will handle successfully unmixed soda and cream of tartar; a good baking powder is much safer and simpler.

There are many hints for gratifying æsthetic tastes in the article on serving. In the feeding of children the naïve question is asked why a child should thrive best upon mother's milk, and it is answered that it is, no doubt, because micro-organisms are found in cow's milk. Sterilized milk may reduce the chances of disease a hundredfold, yet it can not be adapted to a human child as well as the fluid provided by the cunning chemistry of Nature. As well introduce artificial sap into a flower and query why the tints are not true. This leads us to what we deem an important omission in the book—there is no chapter on the nourishment of mothers. If mothers were adequately and properly fed, the preparation of artificial food for infants would need little attention.

A number of useful lists are appended to the book, including the bibliography, apparatus needed by a cooking school, charts on the composition of foods, and an index.

A Clinical Study of Diseases of the Kidney. By Clifford Mitchell, A. M., M. D. Chicago: W. J. Keener, 1891. Pp. 432. Price, $3.

This is a volume intended for a professional audience solely. It has been written, the author states, with particular reference to the bearing of uranalysis upon the diagnosis and treatment of renal diseases and associated disorders.

The recent literature of the subject, particularly that referring to the toxines contained in the urine of persons either in good or bad health and their influence on the organism, is but cursorily referred to; and the pathology in general seems too meager for a work of this character. The author has not been an original experimenter in the field treated of by his work, rather contenting himself in clinically determining the efficacy and truth of the observations reported by others. He has quoted from many of the more recent writers on this subject, and that portion of his work devoted to dietetics and hygienic treatment is very satisfactory. His therapeusis is that of what is called the homœopathic school, and we do not believe that the text-books of homœopathy could more carefully or efficiently discuss the subject.

An Introduction to Practical Bacteriology for Physicians, Chemists, and Students. By Dr. W. Migula. Translated by M. Campbell. New York: Macmillan & Co., 1893. Pp. 247. Price, $1.60.

It is intended that this little volume should serve as a practical guide for a short laboratory course in bacteriology. The apparatus necessary for bacteriological research is described, and instructions are given for examining living bacteria, for preparing nutrient media, for making plate or tube cultivations of micro-organisms, for cultivating these organisms at high temperatures and also without the access of air, for staining the organisms and their spores, and for mounting. Certain of the more important microphytes are described in order that the student may familiarize himself with them. It is not intended that the volume should supplant the larger and well-known text-books on this subject, and it seems that its practical character fits it for a guide for students desiring a knowledge of the elementary principles of this interesting and important topic.

The Soil in Relation to Health. By H. A. Miers, M. A., F. G. S., and R. Crosskey, M. A., D. P. H. New York: Macmillan & Co., 1893. Pp. xvi–135. Price, $1.10.

The object of the authors has been to prepare a work that will give information on the principles of geology in so far as they concern sanitary science. There is a brief review of the origin of rocks, of their decomposition, and of the formation and distribution of soils. The relation of humus and micro-organisms is then discussed, attention being called to the soil being a habitat for pathogenic micro-organisms and to the necessity for preventing soil infection thereby.

The distribution of water in the soil is described, the subject of subsoil water affording an opportunity of presenting Pettenkofer's theory that, as the authors truly state, has not been confirmed. Sufficient reference is made to the relation between the dampness of the soil and the prevalence of phthisis, though the authors seem unaware of Bowditch's pioneer work in this matter.

There is a chapter on the constituents of water derived from the soil, and the influence that certain of these constituents exercise upon the prevalence of certain diseases.

The chapter on the relation of the soil to the air considers not only the movement of ground air, but also the influence of specific heat, radiation and absorption, conductibility, and color of the soil upon the climate.

The final chapter, on the geographical distribution of disease, very properly calls attention to the fact that while disease maps are of great value in indicating the geographical distribution of disease, they can not be used as maps illustrating the geological distribution of disease until statistics are grouped by similar geological areas where the other conditions are absolutely uniform.

There are several errors in the chapter on humus and micro-organisms. It was Laveran, not Marchiafava and Celli, that discovered

the *Hæmatozoon malariæ;* and no bacteriologist or pathologist attaches any importance to Tommasi-Crudeli's alleged *Bacillus malariæ*. The typhoid bacillus was discovered by Eberth, not Gaffky, who simply confirmed in 1884 Eberth's discovery and announcement made in 1880. Nor did Dr. Klein discover the *Bacillus pneumoniæ* in 1888, as Friedländer had made pure cultures of these organisms in 1883. In fact, the bacteriology of the volume has been written by a person having a very limited acquaintance with the subject. No reference is made to Miquel's, Adametz's, Beumer's, Maggiora's, Fränkel's, Giaxa's, Proskauer's, Manfredi's, and Fülles's investigations of the relation of micro-organisms to the soil.

While the book might have been more complete, it is still sufficiently extensive to be of great use to any student of sanitary science.

THE DISEASE OF INEBRIETY FROM ALCOHOL, OPIUM, AND OTHER NARCOTIC DRUGS. Arranged and compiled by the American Association for the Study and Cure of Inebriety. New York: E. B. Treat. Pp. 400. Price, $2.75.

THE association named above was organized in 1870, and has a membership composed of physicians connected with asylums for inebriates, and other persons interested in the study of the drink problem. Its cardinal doctrine is that inebriety is a disease, and is curable as other diseases are. It further postulates that all methods hitherto employed for the treatment of inebriety that have not recognized the disordered physical condition caused by alcohol, opium, or other narcotics have proved inadequate in its cure; hence the establishment of hospitals for the special treatment of inebriety, in which such conditions are recognized, becomes a positive need of the age. The association has been in the habit of holding annual and semi-annual meetings, in which a large number of papers have been presented, read, and discussed. Six volumes of Transactions were issued, and the Quarterly Journal of Inebriety was established. Its special work has been to gather and group the scientific literature of the subject and make it available for future study. In addition to this literature many members of the association have published volumes on the subject; valuable papers have appeared in this country and Europe. Many of these works having passed out of print, the secretary of the society, Dr. T. D. Crothers, was authorized to prepare a volume to contain the most reliable conclusions and studies of eminent authorities on all phases of the disease up to the present time. In this volume are discussed the etiology, pathology, treatment, and medico-legal relations of inebriety. The selections have been gathered from more than five thousand pages of printed matter published in the Journal and Transactions, and are from papers which have not appeared elsewhere, and hence will be new to most physicians. But it is acknowledged that, while the facts are very numerous and startling and fully sustain the principles of the association, they are not yet sufficiently studied and generalized to be accepted as absolute truths.

MISSOURI BOTANICAL GARDEN, FOURTH ANNUAL REPORT. St. Louis: Published by the Board of Trustees. Pp. 226, with 23 Plates. Price, $1.

WHILE no extensive improvements have been undertaken at the garden during the year, the liberal appropriations made for its support have been judiciously expended, and the accounts show a handsome surplus of funds. The library contains now 11,455 books and pamphlets, and the herbarium 203,000 sheets of specimens. The number of visitors to the grounds has considerably increased as compared with previous years; and so far as could be gathered from their remarks, they have shown an appreciation of the improvements that have been made, especially of the more natural grouping of the plants, and of the addition of large specimens of cacti, yuccas, etc., from the arid regions. The last include a number of representatives of characteristic species from the dry districts of Texas, Arizona, and California. The additions to the herbarium have consisted of the current American collections, about three thousand duplicates from the herbarium of the late John Ball, a set of the valuable *Exsiccatæ* of the Austrian flora, given by the Vienna Museum, and many smaller collections and single specimens presented by correspondents. A card index to the species of plants described and figured in works at the garden has been begun; and

the large collection of pamphlets has been put in shape for permanent preservation. Dr. E. Lewis Sturtevant has presented to the garden his extensive and valuable collection of specimens, manuscripts, and illustrations, largely in color, of the genus *Capsicum*, on condition that the genus should be studied with reference to an ultimate monograph of the wild and cultivated forms; and preparations have been made to supply living material for this study. He has further presented his entire botanical library, including the scrapbooks of his own writings and his manuscript notes on edible plants, on condition that he enjoy the use of the books during his life or so long as he wishes them. This library is said to be the most complete and valuable American collection of pre-Linnæan botanical books. The course of study for garden pupils has been shortened to four years, without omitting any of the manual work or any of the studies originally included. Undergraduate engineering students have been secured in the School of Botany for a study of the histological and other means of distinguishing timbers. The volume of the report contains the three regular anniversary publications—the Flower Sermon, which was preached by the Rev. Cameron Mann; the proceedings of the Banquets to the Trustees of the Garden and to Gardeners, Florists, and Nurserymen; a list of Plants collected in the Bahamas, Jamaica, and Grand Cayman; and Additional Notes on Yuccas and their Pollination, by Prof. Trelease, to which most of the twenty-three photogravure plates are illustrations.

HOUSEHOLD NEWS. Monthly. Edited by Mrs. S. T. RORER. Philadelphia: Household News Company, Limited. Price, $1 a year.

THE first number of this new household magazine was issued in July. Its editor is the head of the Philadelphia Cooking School and author of a successful cook-book, besides smaller special manuals on Hot Weather Dishes and Canning and Preserving. Cookery, Mrs. Rorer's specialty, occupies most space in the magazine. Under this head in the first number is a series of seventeen bills of fare, with explanations of their novel features, an account of the corn kitchen at the World's Fair presided over by Mrs. Rorer, answers to inquirers, and miscellaneous recipes. The Department of Diet and Hygiene, in charge of Dr. Charles M. Seltzer, contains a leading article and answers to inquirers. Dr. Henry Leffmann, widely known as the author of books on chemical and sanitary subjects, has a department of Household Chemistry, to which he contributes an article on Water in the Household. The Nursery Department is under the guidance of Dr. D. J. Milton Miller, physician to the Children's Hospital and to the Episcopal Hospital in Philadelphia. Other departments are the Kindergarten, conducted by Mrs. M. L. Van Kirk and Miss M. G. Clark; Decoration, by Mrs. Hester M. Poole; Architecture, by Isaac Pursell; and Literature, by Miss Elizabeth Carpenter. A department on the Nurse is to be added. The field of dress is left to magazines devoted exclusively to that subject. There seems to be no room in this periodical for the trash that is too common in so-called "ladies' journals." Its tone is eminently practical, and as there are plenty of housewives who prefer sense to nonsense it has good prospects for generous support.

SOAP MANUFACTURE. A Practical Treatise on the Fabrication of Hard and Soft Soaps, etc. By W. LAWRENCE GADD, F. I. C., F. C. S. New York: George Bell & Sons (Macmillan & Co.). Pp. 218. Price, $1.50.

THERE is probably no manufactured article that is used more generally and is of more importance in the household than soap, and yet there is perhaps no substance about which the ordinary consumer knows so little, either as regards composition, methods of manufacture, or adaptation to its various uses. The prevalence of the minor forms of skin diseases, for example, is very general, and there is little doubt that many cases are due, in part at any rate, to the use of improperly prepared soaps, while others are rendered more serious by applications of some of the various medicated soaps, which are so numerous, and often of no medicinal value.

The first chapter of the book introduces the reader to the chemical reactions in soap-making, a knowledge of which is necessary for understanding the subsequent processes, and also gives a few words on the antiquity of the manufacture of soap and its growth as an industry.

The next chapter, entitled Fatty Acids, contains an account of these as they occur in the various essential oils used in soap-making. Chapter III, headed Materials, is devoted to a consideration of the various raw materials employed in the manufacture, the methods of preparing them for use (refining processes), and accounts and cuts of the necessary machinery. Chapter IV deals with the water used in soap manufacture, detailing the undesirable impurities and giving methods for removing them.

The next chapter, on The Manufacture of Soap, gives an account of the essentials of the art as it is practiced to-day. This is followed by a chapter on Packing and Stamping. Chapter VII considers special soaps; Chapter VIII, toilet soaps, and Chapter IX the perfumes commonly used. The next chapter is an account of the methods used for recovering the glycerin set free in the process of saponification. The last chapter consists of a systematic scheme of soap analysis.

The book, although not intended as a popular treatise, contains much that is suited to the untechnical reader, and for one with a little chemical knowledge, who desires to know something of the manufacture of this important article, it is a good text-book. The cuts and detailed descriptions also make it valuable to the manufacturer.

THE PURSUIT OF HAPPINESS. By DANIEL G. BRINTON, LL. D. Philadelphia: David McKay. Pp. 292. Price, $1.

To seek for happiness and to be happy is not only a legitimate aim in life, but, according to Dr. Brinton, there is no higher object; it alone makes life worth living. The altruist may label this pure selfishness and proclaim that our duty is to live for others; the ascetic may extol self-abnegation as the greatest of virtues; yet if we are to diffuse happiness, we must first be charged with it ourselves—"he wastes his life who devotes his time to anything else than the pursuit of happiness or the search for truth." These quests may be identical, for the first step in learning how to be happy is to get knowledge. Even through "the yearning for joy" evolution has come to us; in groping for pleasurable sensation the amœba has developed into man. The human individual attains happiness when his self-consciousness is brought into harmony with his faculties and surroundings. This involves growth and action. Happiness is not momentary pleasure, it is even compatible with physical pain and mental suffering if these enhance the realization of self. To be happy, one must work and fight as for the promised land. It follows that there is an art of felicity whose laws we may study.

The author considers in detail what are the conditions of happiness; how far it depends on Nature and fate, how far it may be controlled by ourselves and by others, and, finally, what are the consolations of affliction.

On the whole he is a cheerful philosopher, although his view of old age is somber —"a malady that is absolutely fatal," whose pleasures are tolerable. To women he accords justice rather than flattery, for which rare tribute they should be grateful. There is excellent advice to be found in the book, and, unlike many treatises that offer it, this is entertaining and free from pretense or cant of any sort. The range of topics, however, is wide and we meet strange maxims: less than your best will often answer the purpose, and good enough is good. We query whether the author would be satisfied to have these taken as the gauge of his work.

THE DISEASES OF THE STOMACH. By Prof. C. A. EWALD, M. D. Translated by MORRIS MANGES, M. D. New York: D. Appleton & Co. Pp. 497. Price, $5.

THIS is a translation of a work that has gone through three editions in Germany, a statement that implies intrinsic merit in a work on a medical subject. This translation has had the further advantage of the author's revision, and thus includes his most recent studies on this subject.

The work is arranged in a series of twelve lectures as they were delivered in the author's course at the University of Berlin; the subjects include the methods of diagnosis and the various diseases of the stomach. The chapter on the neuroses of the stomach is by Prof. R. Ewald.

The author is a clear and logical writer, presenting all the facts that will assist the clinician in making his diagnosis. But he

calls attention to the fact that not even the most careful chemical examination of the functions of the stomach will put within our grasp the divining-rod that will, as it were, "magically call forth the fountain of knowledge from the adamantine rocks of obscure symptoms."

The reputation that the American people have of being a nation of dyspeptics is not altogether without foundation; and where gastric disorders are even moderately prevalent, such a work as this must be of value in enabling all physicians to be well informed regarding the latest methods of diagnosis and treatment of gastric diseases.

The third and concluding volume of Prof. *A. B. Hart's* Epochs of American History—*Division and Reunion*—brings down the narrative from the accession of Jackson to the end of President Cleveland's first administration. In the construction of the series each author has kept his own point of view, and no pains have been taken to harmonize divergencies of judgment; but it is believed that all these substantially agree as to the underlying causes of the growth of our country. The present volume is by *Woodrow Wilson*, and is the work of a master. Only a sketch in broad outline has been attempted—not so much a compact narrative as a synopsis, as rapid as possible, of the larger features of public affairs in the sixty years it covers. The story is told in four parts: the period of critical change, when the spoils system was introduced and sectional divergence began to be disclosed; the period of the prominence of the slavery question; the period of secession and civil war; and the period of the rehabilitation of the Union.

A paper on *The Financial History of Virginia* from 1609 to 1776, published by *William Zebrina Ripley* in the Columbia College Studies in History, Economics, and Public Law, is a contribution to the effort to trace the gradual development of systems and theories in financial management. One does not look, the author says, "to primitive society and its institutions for well-rounded principles and technical details; for to construct a science of finance where there was none in fact, would be to pervert the course of history. Theories do not arise until experience has taught man the abuses attendant upon social life. Consequently the financial history of this oldest American Commonwealth for many years is merely the story of the simple methods adopted by a people too fully occupied in conquering a wilderness to spin fiscal theories, who wanted to support the incipient Government in the easiest possible way." The institution of slavery had a marked influence on the course of development in Virginia, and was the ultimate factor that distinguished this colony from those of New England. The fiscal systems of the two regions became radically different, because the outward conditions of climate, soil, and situation were totally unlike; and the history attests the truth of the law that the direct environment is, after all, the most powerful factor in shaping early social institutions.

The study of *Bankruptcy* in the light of comparative legislation, contributed by *S. Whitney Dunscomb*, Jr., to the Columbia College Series of Studies in History, Economics, and Public Law, comprises a review of the laws and processes of the European nations and the United States relative to insolvency. In the first chapter the conditions are stated which constitute bankruptcy or insolvency under the laws of the several States, and terms are defined. Then the effects are described as to the person and juristic status of the bankrupt, as to his property, and as to the acts performed by him; the operations of bankruptcy; the closing of it, by composition relinquishment of assets, and other methods; the rehabilitation of the bankrupt; and preventive compositions or compositions before bankruptcy. The second part of the essay relates to Bankruptcy in the United States under the National Bankrupt Law and the insolvent laws of the several States.

A book fitting the prominent feature of the immediately present time is *A Brief History of Panics*, "Englished" from the French of *Clement Juglar*, and edited by *De Courcy W. Thom*, who has also furnished an introductory essay setting forth the indications of approaching panic. The book was written before the present disturbances in the money market set in, the premonition of which is spoken of as "a somewhat uneasy feeling about silver," and when some of Mr. Thom's symptoms were already apparent;

yet it conveys the pleasant though now contradicted message that the signs in general justify the prediction "of the steady development of a prosperous period."

In transmitting his *Twentieth Annual Report of the Geological and Natural History Survey of Minnesota*, the State Geologist, *N. H. Winchell*, characterizes the survey, as a State enterprise, as unique in its plan, its supervisory auspices, its slow but uninterrupted progress, and the duration of its personal directorship. Ten years ago, in submitting his tenth annual report, the author ventured to congratulate the university and the State on the success that had accompanied the survey at that date; but the second ten years have been more prosperous than the first ten. The present report contains a paper on the structures and origin of the crystalline rocks, by Mr. Winchell; field observations on certain granite areas, by U. S. Grant; the Mesabic iron range, by N. V. Winchell; the abandoned strands of Lake Superior, by A. C. Lawson; and Diatomaceæ of the Interglacial Drift, by B. W. Thoms and H. L. Smith.

The papers in No. 2 of Volume V of the *Studies in the Biological Laboratory of Johns Hopkins University* are on The Effect of Hæmorrhage and of Fasting on the Proteids of the Blood of Cats, by G. P. Dreyer; The Respiratory Function of some Muscles of the Higher Mammlia, by Theodore Hough; The Latent Time of the Knee-Jerk, by E. C. Applegarth; and The Physiological Effects of Differential Respiration, by Prof. H. Newell Martin and G. P. Dreyer.

A collection of translations of papers on *The Mechanics of the Earth's Atmosphere*, published by *Cleveland Abbe* in the Smithsonian Miscellaneous Collections, includes essays of great technical interest and value by Professors Hagen, Helmholtz, Kirchhoff, Oberbeck, Hertz, and Bezold, Lord Rayleigh, and Professors Margules and Ferrel. Prof. Abbe expresses the opinion that there is a crying need for more profound researches into the mechanics of the atmosphere, and believing that meteorology can be advanced beyond its present stage only by the devotion to it of the highest talent in mathematical and experimental physics, he earnestly commends these memoirs to such students in our universities as are seeking new fields of applied science.

The *Introductory Manual for Sugar Growers* of Mr. *Francis Watts* is the outcome of several years' experience in the West Indies, by which he was shown the necessity for a handbook containing an outline of the principles of agriculture based on modern scientific discoveries, and of the principles underlying the manufacture of sugar. The author hopes that his book may be useful as a starting point for young men beginning their training, and that it may help guide older men to other works. Special attention is given to tropical conditions. (Longmans, Green & Co., $1.50.)

The History of Modern Education, which comprises an account of the course of educational opinion and practice from the revival of learning to the present decade, by Prof. *Samuel G. Williams*, has grown out of the lectures given by the author in Cornell University during the past six years, and comprises the last half of his course on the history of education. It presents a compact, comprehensive, and intelligible summary of the subject. After an introductory chapter on ancient and mediæval education, the history proper begins with the account of the Renaissance, phases of education, educational opinions, and distinguished teachers of the sixteenth century. This is followed by similar notices of characteristics of education in the seventeenth century, the educational reformers and their principles, Female Education and Fénelon, the Oratory of Jesus and Beginning of American Education; then of the eighteenth century, in the general review of which education in New England and New York are characterized, early textbooks are described, and the foundation of colleges and of the University of the State of New York is recorded. Among the "educational characteristics of the nineteenth century" are great activity in literature, etc., Herbert Spencer's treatise, the general diffusion of popular education, professional training of teachers, supervision of schools, industrial and manual training, improvements in method, the kindergarten, and the discussion of the relative disciplinary value of studies. (C. W. Bardeen, Syracuse, N. Y. Price, $1.50.)

Practical Lessons in Language is a man-

ual by Benjamin G. Conklin, the lessons in which are intended to cover the last two years of the primary course, and are graded to suit the capacity of pupils as they advance. A picture is given, or a passage to be read; followed by a heading, Things to Notice, under which are included "development questions," which the pupil is to answer in his own language, and the deductions from his answers; and Things to Do—a title which covers varied exercises, all intended to be of a nature to interest the pupil. The aim throughout the book is to lead the pupil to see and think for himself, and when he has mastered it he will have undergone a course of training in observation and original, spontaneous, literary composition. (American Book Company. Price, 35 cents.)

The Presentation of the Life and Educational Works of *John Amos Comenius*, Moravian bishop, the famous educator, by *S. S. Laurie*, is believed by the author to be the most complete and, so far as he knows, the only complete account of Comenius and his works that exists in any language. In preparing it, the author has gone through all of Comenius's didactic writings, and has written the whole from original sources. The volume contains the life and a synopsis of the principal features of the works of Comenius. The publisher, C. W. Bardeen, Syracuse, N. Y., has furnished the present edition with headlines, five portraits, and a bibliography, with photographic reproductions from early editions of the works of the bishop.

The idea of presenting the handbook *Three Roads to a Commission in the United States Army* (D. Appleton & Co.) was suggested to the author, Lieutenant W. P. Burnham, when, shortly after assuming the duties of Professor of Military Science and Tactics at St. John's Military School, Manlius, N. Y., he was surprised to find so much interest manifested in the army, and more so to find how little was known of its real workings. The most remarkable impressions were entertained regarding the character, hardships, and privations of the rank and file of the army. The fact that a commission could easily be obtained from the ranks was not comprehended, many not knowing that such a thing was possible in time of peace. The author has endeavored to throw sufficient light on these points. The character and extent of the examinations for obtaining a commission from the ranks of the army were considerably changed in 1891 and 1892. The rules governing the examinations are taken from the official records of the War Department, which are based on acts of Congress. The three roads to a commission defined and explained in the book are those from the Military Academy, from the army by the appointment of meritorious soldiers, and from civil life—the least frequented of the number.

Science Stories (J. R. Osgood, McIlvaine & Co., London) is a collection of descriptive essays relating principally to the habits and various features of the existence of different animals and plants, originally contributed by the author, *Daniel Wilson*, to the Glasgow (Scotland) Herald. They are reproduced with the view of encouraging "that popular interest in science which is, happily, a feature of our modern life."

The *American Mental Arithmetic* has been prepared by Mr. *M. A. Bailey* for a drill book in which the principles of written arithmetic, except as applied to large numbers, shall be concisely stated and illustrated. Among its features are the placing of principles and illustrations in parallel columns; the beginning of each subject at the top of a page; the systematic placing of explanations and directions under exercises; the prominence of the combination method; the indication of the number of seconds that should be required for the solution of each example; the introduction, in factoring, of the conception of numbers severally prime to each other; the method of presentation of the metric system; the teaching of percentage without rules or formulas; and practical exercises at various places of business. (American Book Company. Price, 35 cents.)

In the *Commercial Arithmetic* of Headmaster *S. Jackson* (Macmillan & Co.) it is assumed that the reader has a competent knowledge of elementary arithmetic, and therefore the theoretical portions of the work are limited to the methods which are best adapted for commercial calculations. An endeavor has been made to give full and accurate information on all commercial subjects of first-rate importance. Certain methods of readily saving labor are suggested. Emphasis is laid on the immense superiority

of decimal operations over all others, and the adoption of the metrical system and a decimal coinage with the sovereign as the basis is favored.

Mr. *Francis Browning Owen*, of Cloquet, Minn., published a volume of poems twenty years ago, and now offers a second and enlarged edition of his writings under the title of *Columbian and other Poems*. His aim has been throughout to write nothing but what would elevate mankind, and to give utterance to "soul-language" rather than to mere words. (Ann Arbor, Mich.: The Register Publishing Co.)

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Arizona, University of. Annual Register, 1892-1893.

Bandelier, A. F. The Gilded Man. D. Appleton & Co. Pp. 302. $1.50.

Brooklyn Ethical Association. Factors in American Civilization. D. Appleton & Co. Pp. 417. $2.

Car No. —. Chicago: The Ferris Wheel Co. Pp. 22.

Dawson, Miles Menander. Elements of Life Insurance. Chicago: Independent Printing & Publishing Co. Pp. 163. $2.

Elloart, Arnold. A Guide to Stereochemistry. New York: Alexander Wilson. Pp. 104. $1.

Gratacap, L. P. As to the Public Schools. Pp. 32.

Guide to the Exhibits of the American Wool Manufactures, World's Columbian Exposition. Pp. 34.

Gunzburg, B. Railway Passenger Cars. St. Petersburg: The author. Pp. 4.

Hatch, J. L., M. D. Consciousness from a Biologic Point of View. Reprint from University Medical Magazine. Pp. 4.

Henderson, Charles R. An Introduction to the Study of the Dependent, Defective, and Delinquent Classes. D. C. Heath & Co. Pp. 277. $1.50.

Howard, B. Douglas. Life with Trans-Siberian Savages. Longmans, Green & Co. Pp. 309. $1.75.

Howells, W. D., Mark Twain, and Others. The Niagara Book. Buffalo: Underhill & Nichols. Pp. 235. $1.25.

Hughes, Robert M. General Johnston. D. Appleton & Co. Pp. 353. $1.50.

Illinois State Board of Health. Zymotic Diseases in Chicago. Pp. 51.

Kemp, James F. The Ore Deposits of the United States. Scientific Publishing Co. Pp. 302. $4.

Kirkpatrick, E. A. Inductive Pyschology. Winona, Minn.: The author. Pp. 104.

Linnæan Society. Abstract of Proceedings, 1892-1893. New York. Pp. 41.

Massachusetts Institute of Technology. Courses in Electrical Engineering and Physics. Boston. Pp. 45.—Department of Chemistry. Pp. 16.

MacDonald, Arthur. Abnormal Man. Washington: Bureau of Education. Pp. 445.

Marcou, Jules. The Geological Map of the United States and the United States Geological Survey. Cambridge: The author. Pp. 56.—A Little More Light on the United States Geological Survey. Pp. 11.

Michigan. Report of the State Board of Health, 1890. Pp. 331.

Minnesota. Geological and Natural History Survey. Bulletin, No. 8. Pp. xxiv + 48.

Minnesota. Souvenir Manual of the Minnesota Educational Exhibit at Chicago, 1893. Frank T. Wilson, Stillwater, Minn., General Secretary, Pp. 112.

Ohio. Board of State Charities. Report of Committee on Prisons. Pp. 42.

Orndorff, W. R. A Laboratory Manual in Organic Chemistry. D. C. Heath & Co. 40 cents.

Osborne, Grover Pease. Principles of Economics. R. Clarke & Co. Pp. 454. $2.

Poore, George Vivian. Essays on Rural Hygiene. Longmans, Green & Co. Pp. 321. $2.

Ridgway, Robert. Birds collected on the Islands of Aldabra and Assumption. Pp. 4.

San Francisco Microscopical Society. Transactions. Volume I, Part 1. Pp. 72.

Spencer, Herbert. The Inadequacy of Natural Selection. D. Appleton & Co. Pp. 69.

Stoddard, William O. On the Old Frontier. D. Appleton & Co. Pp. 340. $1.50.

Taylor, D. W. Resistance of Ships and Screw Propulsion. Macmillan & Co. Pp. 234. $3.75.

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United States Commissioner of Labor. Seventh Annual Report. Volume II. Pp. 843-2048.

United States Department of Agriculture. Weather Bureau. Bulletin of the N. D. Weather and Crop Service. July, 1893. Pp. 15.

United States Marine Hospital Service. Abstract of Sanitary Reports. Volume VIII, No. 34. Pp. 743-780.

Vivian, Thomas J. The Status and Extent of American Domestic Water Commerce. Washington: The author. Pp. 24.

Willett, James R. Heating and Ventilation of Residences. Chicago: The author. Pp. 34.

Wright, Mark R. Heat. Longmans, Green & Co. Pp. 336. $1.50.

POPULAR MISCELLANY.

Spencer's Education in English Training Colleges.—For several years Herbert Spencer's book on Education has been a text-book in the schools of England and Wales which correspond to normal schools in America, and has been very highly appreciated. Mr. J. G. Fitch, the widely known educator, who is one of H. B. M.'s chief inspectors on the training colleges for schoolmistresses, says of this work: "In my conferences with the staff of teachers I have occasionally heard that the work of Mr. Spencer was regarded as incomplete and unsatisfying, that it left out of view some important factors in moral training, and that in particular it exalted scientific instruction at the expense of the 'humanities.' But, withal, it is generally

acknowledged to be one of the most stimulating and suggestive treatises on education in the language; and those of the lecturers who have made the book a theme for comment, and occasionally for adverse criticism, speak in the strongest terms of the value of that intellectual discipline which is to be had in discussing both its shortcomings and its many merits." That its alleged imperfections were not deemed very serious even by their discoverers is shown by the fact that, although Locke's Thoughts on Education was permitted as an alternative, Spencer's book was chosen, in 1891, by all but the two Catholic colleges and one other out of twenty-six. Mr. Wilde, one of the inspectors of colleges for schoolmasters, reports that the students "had in all the colleges given to me invariably taken this book." Mr. Byrne, another inspector, speaking of the general influence of the book, says: "Mr. Spencer's little work on education is doing an incalculable amount of good to the elementary teachers of the rising generations. The obligation now imposed on them to study it is bearing fruit by awakening in them an interest in the proper ends and methods of education and instruction which they had never possessed before. That their occupation is an art, and does not consist in obedience to a number of arbitrarily devised rules, is something to have learned."

Pennsylvania Folk Lore.—Dr. D. G. Brinton's account of the folk lore of his early home in Chester County, Pennsylvania, has little that is peculiar, but in most of its traits recalls familiar English customs. The usual superstitions about the moon were in vogue, and there was a mysterious buried treasure of blood money with a legend attached. Some mythical animals were believed in; among them a descendant of the were wolf of the middle ages—a big black dog with fiery eyes, which never appeared except at night, and was an object of terror to those who heard him. He was supposed to haunt a certain valley which people avoided. Another animal of this class was the hoop snake, which was said to form itself into a ring with its tail in its mouth, and to revolve like a wheel, faster than a horse could trot. Dragon flies, as "snake servants," were supposed to warn snakes of approaching danger, and as "snake-feeders," to seek out food and notify the snakes where it could be found. Cats were uncanny; many animals could predict the weather; and "conjuring" was held responsible for many ills, while charms were cherished as competent to remove them. Ghosts were familiar in popular belief, and were in many cases associated with spots connected with scenes of the Revolution. The author was himself somewhat of a ghost-seer in his early days—a faculty which he regrets having lost as he advanced in years. Having such evidence of his own, he was quite prepared to accept without question the statements of others on such points. The later influx of Irish laborers has introduced a mass of folk lore and superstitious notions that did not exist in the region in the author's boyhood. For instance, he never heard that Friday was an unlucky day, or that the number thirteen at dinner was ominous, or that one should stroke himself to avoid the influence of a bad sign.

Animal Life in the Death-Valley Region.—A pointed illustration of the effect of change of environment on the life of a region is given in Dr. A. K. Fisher's report of the birds observed in the course of the examination of the Death-Valley region, California, undertaken by Prof. C. Hart Merriam, under the direction of the Department of Agriculture. While the bird life of any region is affected by various agencies, such as the results of the destruction of forests, the drying of springs and watercourses, etc., in the high Sierra the sheep industry is doing more than any other cause to make that region uninhabitable. During the summer the sheep destroy all the smaller plants and shrubs to such an extent that they do not grow again till the following spring. The author has walked for miles along the hillsides where sheep had recently grazed without seeing any plants except the larger woody shrubs. That this destruction is a potent cause of the scarcity of ground-inhabiting birds is evident by contrast to any one visiting the national parks, where no sheep are allowed to graze, and where vegetation is consequently uninjured and many species of birds abound. Yet two hundred and ninety species and subspecies of birds were found in this region,

and are reported upon. The collection of reptiles and batrachians made by Mr. Leonhard Stejneger is particularly noteworthy as being the first attempt in this country on a similar scale to gather the material of this class according to a national plan and with a definite purpose in view. The result is a fine series of nine hundred specimens, unique in its completeness with respect to geographic localities within the area explored by the expedition, a tract of almost a hundred thousand square miles, comprising a number of nearly parallel desert valleys separated by intervening narrow mountain ranges. The effort to collect every species in all the characteristic localities has resulted in the accumulation of a material by which it has been possible in many instances to follow the geographic variation in its several directions. Thereby the author has been enabled to settle many vexed questions, and to point out various nice distinctions where some of his colleagues had failed, chiefly from lack of suitable material. According to Prof. Merriam's own observations, most of the desert shrubs are social plants and are distributed in well-marked belts or zones, the vertical limits of which are fixed by the temperature during the period of growth and reproduction. The boundaries of the several belts conform largely to the contours of altitude, with such flexures as variations in base level and slope exposure impose.

Conventionalism and Originality.—Having discussed the tendency of conventional and original minds to come into collision on social matters, the London Spectator finds the occasions for collision less in the case of purely intellectual questions, for the conventionals would take so little interest in matters requiring real thought that they would dismiss them unconsidered. But to those capable of appreciating such subjects, how refreshing in their distinctiveness of character are the workings of the original mind, both in ideas and in expression! For there is a touch of genius, or what the French call *feu sacré*, kindling its thoughts. "Life can never be an altogether dull thing in the company of the original man, for his inventive mind will so combine its various elements as to produce a new and unexpected result. He will see things from some point of view disregarded before; like what we have seen, yet somehow quite different—fresh and unexpected as the thoughts of a child. For, in truth, we shall find there is a close kinship between his mind and that of a thoughtful child. Both continually surprise and delight us, because, through ignorance in the one case and disregard in the other, of the ordinary points of view, they simply and naturally take their own. And in both cases there is the probability that they will strike the truth, because, unblinded by convention or prejudice, they aim straight at the heart of a question. We see, both with children and with poor people, that education, however useful as a refiner of the raw material of originality, is no necessity of its existence. For what rare and racy originality do we often find in the sayings of the poor and uneducated! Their conversation may be often richer in this golden ore than that of those who are called their betters; for having heard less of other men's views, their shrewd, observant minds are driven to take their own. . . . Yet, on the other hand, who that delights in certain gifted authors would deny that mental cultivation gives an added grace to originality?"

The Alaskan Climate.—The climate of southeastern Alaska, says Prof. J. J. Stevenson, in the Scottish Geographical Magazine, is a source of constant surprise to visitors from the Atlantic slope. On the same parallels with bleak and dismal Labrador and Cape York on Hudson Bay, where the summer heat penetrates only a few feet below the surface, trees grow three thousand feet above the sea at Wrangel, and up to the mountain tops at Juneau. The rainfall is great, and the variation in temperature is not; the mercury rarely falls below ten degrees above zero at Sitka, and as seldom rises above seventy-five degrees. Of course, the extremes are much greater on the mainland beyond the mountains, where the summer heat and winter cold are much more intense than immediately on the coast. Alaska has not been an unprofitable investment for the United States. The purchase money has been repaid, or nearly so, by royalties on seal-fishing. But the agricultural capabilities are limited indeed. There is little land fitted for tillage; and the moist summer

with its low temperature is unfavorable for the ripening of grain. Gardens, however, are successful at Sitka and Wrangel, and the commoner vegetables are raised without difficulty. Berries of many kinds grow luxuriantly. The remarkable contrast between the Atlantic and Pacific coasts of North America is due to the influence of the Kuro-Siwo, or great Japanese current, which is similar to that of the Gulf Stream on the west coast of Europe. There are many points of resemblance between the two streams. The Japanese current is divided by a cold current, and fogs are produced by the contact, as they are when the Gulf Stream meets the Labrador current in the North Atlantic. The Kamchatka or northerly branch flows into Bering Sea and passes through Bering Strait into the Arctic Ocean, first striking the coast of northern Alaska; the mild climate of that coast is due to it, and possibly its influence on the ocean temperature has much to do with the presence of fur seals in Bering Sea. The main body of the stream crosses the ocean and reaches the American coast not far from the strait of San Juan de Fuca, whence it flows southward to join the great northern equatorial current off Lower California. In spite of the superfluity of rainy and cloudy weather, southeastern Alaska is said to be by no means an uninviting place. In summer the twilight almost meets the dawn, but winter restores the daylight to the general average, for at Sitka lamps are extinguished at nine in the morning, to be relighted at three in the afternoon.

Characteristics of the Tropical Forest.—To the naturalist, says the London Spectator, the most marked feature of the great tropical forest south of the equator is the inequality in the balance of Nature between vegetable and animal life. From the forests of Brazil to the forests of the Congo, through the wooded heights of northern Madagascar, to the tangled jungles of the Asiatic Archipelago and the impenetrable woods of New Guinea, the boundless profusion of vegetable growth is unmatched by any similar abundance in animal forms. A few brilliant birds of strange shape and matchless plumage, such as the toucans of Guinea and the Amazon, or the birds of paradise in the Moluccas or the Papuan Archipelago, haunt the loftiest trees, and from time to time fall victims to the blowpipe or arrow of the natives, who hardly dare to penetrate that foodless region, even for such rich spoils, until incantation and sacrifice have propitiated the offended spirits of the woods; but, except the sloth and the giant ant-eater, there is hardly to be found in the tropical regions of the New World a quadruped which can excite the curiosity of the naturalist or form food even for the wildest of mankind. In the corresponding tracts of Africa and the Asiatic Archipelago the rare four-footed animals that live in the solitary forests are for the most part creatures of the night, and do not leave their hiding places till the tropical darkness has fallen on the forest, when they seek their food, not on the surface of the ground, but, imitating the birds, ascend to the upper surface of the ocean of trees, and at the first approach of dawn seek refuge from the hateful day in the dark recesses of some aged and hollow trunk. There is nothing like the loris or the lemur in the fauna of temperate Europe. We may rather compare them to a race of arboreal moles, the condition of whose life is darkness and invisibility. But, unlike the moles, the smaller members of these rarely seen tribes are among the most beautiful and interesting creatures of the tropics, though the extreme difficulty of capturing creatures whose whole life is spent on the loftiest forest trees is further increased by the reluctance of the natives to enter the deserted and pathless forests. The beautiful lemurs, most of which are found in Madagascar, are further believed by the Malagasi to embody the spirits of their ancestors; and the weird and plaintive cries with which they fill the groves at night, uttered by creatures whose bodies, as they cling to the branches, are invisible, and whose delicate movements are noiseless, may well have left a doubt on the minds of the first discoverers of the island as to whether these were not in truth the cries and wailings of true *lemures*, the unquiet ghosts of the departed.

Indian Basket Colors.—No chemist, says the Lewiston (Maine) Journal, has ever produced brighter colors than are made by the Maine Indian basket makers. For the greater part of the material, ash logs are

taken, though maple is cut for rims and handles. In the salt marshes sweet grass is found, which when dry gives out a fragrant odor. Alder is steeped for pale red, white-birch bark for bright red, cedar boughs for green, and sumac for yellow. Black comes from white-maple bark. A light solution of maple, however, shows purple instead of black. Lazy Indians buy logwood for black, redwood for red, and fustic for yellow. A family of four basket makers in Oldtown cleared one thousand dollars last year, in addition to the household expenses. In the same house where the baskets were made are a four-hundred-dollar piano, a Brussels carpet, lace curtains, plush furniture, a picture of a priest and one of the Virgin Mary, a Catholic epitome, a set of Cooper's novels a stuffed owl, and a peacock, also stuffed. Two canary birds sang in a cage hanging in the room, and on a mat a tired foxhound snored.

Ancient Beginnings of Chemistry.—In a paper presenting evidences of careful study, Prof. H. Carrington Bolton has shown how the beginnings of chemistry were in the very earliest times, when already many arts were practiced involving chemical operations, such as working in metals, purification of natural salts for pharmacy, etc., dyeing of cloths and the preparation of pigments, brewing of fermented liquors, and others. Hence we find that long before chemistry became a science, even before it became inoculated with the virus of alchemy, furnaces and apparatus of earthenware, metal, and glass, adapted to special work, were in common use. The Egyptians attained great skill in industrial arts at a remote period, and have left records of a most enduring character, pictures cut in their granite tombs and temples. There we see the processes of gold washing and smelting; the use of blowpipes and double bellows for intensifying heat, various forms of furnaces, and crucibles having a shape quite similar to those of to-day. Some of these crucibles preserved in the Berlin Museum date from the fifteenth century B. C. The earliest chemical laboratories of which we have any knowledge are those connected with the Egyptian temples. Each temple had its library and its laboratory, commonly situated in a definite part of the huge structure. In these laboratories the priests prepared the incense, oils, and other substances used in the temple services, and on the granite walls were carved the recipes and processes. These are still to be seen by the archæologist. The Israelites carried with them from Egypt to the promised land knowledge of the technical and artistic skill of their contemporaries, and the Holy Bible contains frequent allusions to industrial arts. Cupellation is plainly described by Jeremiah; metallurgical operations are mentioned in Job, Ezekiel, and other books, and bellows by Jeremiah. Geber, the Arabian physician and chemist of the eighth century, wrote very plainly of chemical processes, describing minutely solution, filtration, crystallization, fusion, sublimation, distillation, cupellation, and various kinds of furnaces and apparatus employed in these operations. He describes in detail the aludel (or sublimatory of glass), the necessary apparatus for filtration, and the water-bath. The last piece (*bain-marie* in French) is said to have been invented by an alchemist named Mary, who is identified with Miriam, the sister of Moses. Perhaps the earliest drawings of strictly chemical apparatus are those in the so-called manuscript of St. Mark, which is a Greek papyrus on the "sacred art" preserved in Venice and recently edited by Berthelot.

Adaptability of the South to Cotton Manufacturing.—The feasibility of establishing profitable cotton manufactures in the Southern States was recently discussed in the Manufacturers' Record of Baltimore by D. A. Tompkins, of the Atherton Mills, Charlotte, N. C., and Henry G. Kittredge, editor of the Boston Journal of Commerce. Mr. Tompkins believes that the conditions at the South are more favorable to the manufacture of cotton than those of any other part of the world—because no freight charges or only trifling ones have to be incurred; the profits of dealers in cotton are eliminated; labor and living are cheaper than in other parts of the United States; the cost of bagging and ties is almost entirely saved, because they can be sold back to the farmers; and the loss of cotton in transportation to other points is saved. Mr. Kittredge does not regard these advantages as

of permanent consequence, or as such as can not be offset by things unfavorable; and he mentions as an opposing condition of great magnitude the enervating effect of the Southern climate. He points to the region within the limits of the Appalachian Mountain system, where the climate partakes to a greater or less degree of the characteristics of that of the Northern States, as the most propitious region for the establishment of the cotton manufacture of the South. The Record expresses the belief that the delightful and salubrious climate of the Piedmont region of the Carolinas lacks nothing needful for successful manufacturing operations.

German Schools.—According to a summary of the German school system by Principal Ernest Richard, of the Hoboken Academy, the people's school (*Volksschule*) comprises a course of eight years in the common branches, with natural history, geography, history, and religion, from which everything that belongs properly to the competency of special schools is carefully kept out. The spirit of these schools, however, changes, according to the relative strength of liberal or reactionary tendencies in the spirit of the times. In many States a compulsory course in the *Fortbildungsschule*, or continuation school, has been introduced, to attend which employers are obliged to give all their employed below a certain age leave of absence. The course in these schools is generally an enlargement of the subjects taught in the people's schools, with a view to the future occupation of the pupils. In the city they try to give instruction most useful for the prospective mechanic, while in agricultural districts the future needs of the farmer are of leading influence in shaping the course of study. Girls are trained in domestic economy and prepared for their future position of wives and mothers. Special trade schools, or industrial or commercial schools, adapted to the special occupations of the place, are also open to the boy who has completed his people's school course. From these elementary schools, with a variety of other schools which one may attend, the pupil passes to the secondary schools—the *Ober-Realschule* the *Realgymnasium*, and the Gymnasium; or the schools of science and modern languages; of these with Latin added; and the humanistic school. These schools are in nine grades, which all have Latin names, from *Prima superior* (the highest) to *Sexta* (the lowest). At the close of the complete secondary course the *Abiturienten Examen* takes place, an examination of maturity for work in the university and the highest technical schools of university rank. The university is considered the soul, the life-giving element of education. Its proper province, even more than preparation for a profession, is, as Prof. Virchow has shown in his rectoral address published in the August Monthly, the search for truth for the sake of truth, the production of new knowledge, the providing of material for the progress of civilization in all its branches. No matter what the political constitution of the State may be, it is free; and the professor's right to teach what in his conviction is the truth is not limited.

Accuracy of American School Books.—The results of an offer recently sent out by the manufacturers of an article of popular use of a prize for the detection of errors in school books are very creditable to the accuracy and thoroughness of American textbooks. The conditions of the offer required that the book be in the English language and actually used in some school, and the error one susceptible of proof, and taught in lectures or lessons, and not merely a typographical mistake, or an error inadvertently made in spelling or grammar; it should not be one that had already been corrected in later editions; it should not be a disputed question of history or opinion; and should be usually recognized by the publisher of the book on submission to him as an error. Two hundred and thirty-five answers were received to the offer, representing one hundred and sixty-eight alleged errors. The greatest number of errors—thirty-eight—were alleged to appear in geographies; next were histories, twenty-one; arithmetics, nineteen; grammars, sixteen; natural history, twelve; readers, ten; chemistries, eight; languages, etymology, civil government, seven each; geometries, four; geologies and miscellaneous criticisms, two each; definitions, zoölogies, books on English, anatomies, astronomies, botanies, drawing-books, trigonometries, and political economies, one each.

Only one misstatement was found in Webster's Dictionary, and only two in Prof. Fiske's Civil Government in the United States. Another offer, on slightly modified terms, has been sent out by the same house, which will doubtless lead to a still more thorough examination of the books. From the present outlook, whatever may be the shortcomings of our school books, they do not lie to any great extent in outright misstatements of fact.

Expenses at Harvard.—The cost of living while at school is a very important item to most college students. Since Prof. Palmer, of Harvard University, showed how it was possible for a student to live there on four hundred and fifty dollars a year, or a little less, many changes have taken place in college life and its surroundings, and aids to economizing have been introduced that did not exist then. In the Foxcroft Club, with its bill of prices ranging from two slices of bread or two cookies for a cent, to ten cents for roast meats, many have been able to board for as little as two dollars a week. The Twenty-one Club has been an active force in lowering the average of student expenses; the Furniture Loan Club, which began in 1890, has been another. The list of rooms in private houses, published at the opening of each college year, has aided, by directing students to the cheapest rentals; and an employment bureau, established in 1887–'88, helps students who may wish to earn their way or a part of it. In order to ascertain the present conditions as to expense, Secretary Frank Bolles recently requested a number of Harvard men to prepare, each in his own way, a statement of his necessary expenditures during the time of his residence at the university, selecting men known to be very poor, earnest, and scholarly, eager to secure remunerative work, and likely to be methodical and accurate in money matters. He publishes, in a pamphlet entitled Students' Expenses, the replies received from forty of them. These replies show that "students of the most intelligent kind are able to meet the expenses of an academic year by a sum appreciably smaller than the four hundred and fifty dollars which was the normal minimum in 1887." As a rule, the letters have a cheerful tone, showing that the student who lives economically "is not necessarily dreary," though he may have less of pleasure and ease than many of his associates. While some of the men have been forced to devote too much time to making money to attain the very highest grade of academic scholarship, few of them have records below the average; and the number of those having conspicuously high records is greater than that of those having poor grades. Several of them have taken active part in athletic supports, and have found time to enjoy themselves in other ways.

The First Climbing of an Alp.—According to Mr. Edwin Swift Balch's interesting paper on Mountain Exploration, the first real Alpine ascent took place in the same year as the landing of Columbus, when Chamberlain Julien de Beaupré, by order of King Charles VIII of France, and with the help of ropes and ladders, climbed Mont Aiguille, "a long narrow wedge, six thousand and eighty feet high, flat at the top, where there are grass and trees." The contemporary account reads that "on June 26, 1492, François de Bosco, almoner to the Seigneur Julien de Beaupré, in company with other hardy adventurers, ascended the Mont Eguille, or Mount Inaccessible, and the day following, having said mass on the said mountain, ate, drank, and reposed thereon. The Seigneur Julien de Beaupré changed the name of the mountain from Eguille, or Montagne Inaccessible, to Eguille Fort, causing it to be baptized in the name of the Holy Trinity by a certain Sébastian de Carect, one of the royal chaplains, and afterward chanting the *Te Deum*, *Salve Regina*, and many other anthems." They saw numerous chamois on the summit, where they spent six days, and found the descent still more horrible than the ascent.

The Zoölogical Garden of Philadelphia.—The Directors of the Zoölogical Society of Philadelphia say in their report for the last year that they have been confined in the administration of the affairs of the society to its legitimate purposes, by the provisions of its charter and their sense of a proper conduct of the trust confided to them. Their constant object has been to place the garden —purely as a zoölogical garden—in the

front rank of such institutions. In this they feel that they have succeeded in a greater measure than is perhaps commonly recognized by the people of the city. The public services rendered by such an institution are comprised in the very definition of education, in its broad modern sense, and need demonstration in this day quite as little as do its other functions in the direction of recreation; yet it is doubtful if the general public perceive as yet the full educational value of an institution that attracts at the same moment, into the same path, two such different elements of human intelligence as the capacity for observation and the love of enjoyment. The last year's season of the garden was less profitable than usual, partly on account of the severity of both the summer and the winter, and partly also, the directors fear, because it has become the victim of that sort of popular apathy to which such institutions are exposed which eschew sensational methods and are not all the time offering novelties. It is to be hoped that the intelligent people of Philadelphia will not permit so worthy an institution to suffer on account of its determination to maintain its high standard.

Ancient Mexican and Hopi Dances.—Certain resemblances, fancied or real, between ceremonials which, according to Spanish historians, were observed by Central American aborigines at the time of the conquest, and those which are at present performed in the least modified of the pueblos of the Southwest, afford a series of interesting facts, which, if they do not point to the kinship of those peoples, may throw light on the study of the comparative ceremoniology of the American race. An example of such resemblance is found by Mr. J. Walter Fewkes in a ceremony described by Padre Sahagun as practiced by the ancient Mexicans, which is comparable in many respects with the Hopi snake dance. In his published study of the subject, Mr. Fewkes gives the Nahuatl text cited by Sahagun, a German translation of it by Dr. Seler, an English translation of that, and a Spanish version with a Mexican plate or tablet illustrating the text. There are many differences between the described ceremony and the Hopi dance, but a striking resemblance appears in the carrying of the snake in the mouths of the participants. The resemblance leads one to look for likeness in symbolism, especially as appertaining to the mythological snake, between the two peoples. A close likeness in this symbolism has not been found among the Nahua people, while with the Mayas there is a remarkable case of similarity or identical symbolism apparently connecting the plumed snake of Yucatan with that of the Hopi towns. From the speculative side there seems probable an intimate resemblance between some of the ceremonials, the symbolism, and the mythological systems of the Indians of Tusayan and those of the more civilized stocks of Central America. In the author's opinion, we are not yet justified in offering any but a theoretical explanation of the origin of the Hopi ceremonial and mythological systems, but their intimate relations with those of the neighboring pueblos indicates a close kinship. The facts recorded in his study look as if the Hopi practice a ceremonial system of worship with strong affinities to the Nahuatl and Mayas. He has not yet seen enough evidence to convince him that the Hopi derived their cult or ceremonials from the Zuñians or from any other single people. It is probably composite.

NOTES.

Polygonum sakhalia is the name of a forest plant from the island of Sakhalien, Japan, of which flattering accounts are given by M. Doumet Adanson, who has cultivated a few stools of it in France. He got it as an ornamental plant, and it is really very handsome. It grows to be about six feet high in three weeks; produces a considerable foliage of which cattle are fond; and yields a good second crop after the first cutting. A section of root planted will produce a stool covering a square metre of surface. It takes care of itself.

A LEAGUE has been formed at Aix-en-Provence, France, for promoting agricultural interests by preserving the small insect-eating birds, and has allied itself with state and local authorities. It will seek to suppress nets and all machinery for capturing birds; to insure the preservation of nests; to forbid the manufacture and sale of spring nets and other bird-catching machinery, and to prohibit the use of poisons and of bird-lime against birds, and in general of anything except the gun for their destruction. It will favor the use of all means for the res-

toration and renaturalization of all useful species that are now tending to disappear. It will also strive to enlist the co-operation of the authorities and administrative officers in all practical measures to save the birds, and so to instruct the public that a generation shall grow up who have not been taught by the example or indifference of their elders that birds are mischievous creatures, to be got rid of, but the contrary.

THE second medallist of the Royal Geographical Society this year (M. Selous, the African explorer, being the first) was Mr. Woodland Rockhill, an American diplomatist, who had made himself famous by his explorations in western China and northeastern Thibet.

A WRITER in the *Génie Civil* has shown that there is a difference in electric potential between the water and gas pipes in all houses, and that if one terminal of a telephone is joined, say, to the water pipe, on lightly touching the gas pipe with the other, a crackling sound will be heard in the telephone, indicating the passage of a current. When the telephone is replaced by the galvanometer, the negative pole is found to be formed by the gas pipe, and the galvanometer deflection to be permanent and constant in amount during several months, but with a slight diurnal variation. The currents are attributed to slow chemical changes. With the currents developed in these pipes the author has succeeded in carrying on a conversation between two houses a hundred metres apart.

A GORILLA which had acquired considerable fame died recently in the Berlin Aquarium. The papers have published accounts of its daily operations. It awoke at eight o'clock in the morning and took a glass of milk. At nine o'clock it made its toilet with as much care as a civilized man, and ate its breakfast a few minutes afterward. This consisted of two Vienna loaves, Hamburg smoked meat, cheese, and white beer. At one o'clock in the afternoon it had a cup of chicken soup with carrot, rice, and potatoes, and an egg. Its evening meal consisted of fruits, bread and butter, and a cup of tea.

THE Hindus are curiously frank in specifying their occupations for the census reports. Among the accounts many of them give of their trades they designate themselves as debtors, living on loans, men of secret resources—or plainly thieves, village thieves, or robbers. Others more modestly call themselves guests, visitors, story-tellers from house to house, dependents on relatives, supported by their sons-in-law, or idlers; and one is without work because he is silly. Among the more serious occupations are declarer of oracles, cleaner of eyes, sorcerer, foreteller of storms and hail, player of the tom-tom, or player, barber, doctor according to the Greek method, servant of a candidate, marriage broker of young domestics, marriage broker of his own daughters for money, etc.

ACCORDING to an address by C. Theodore Williams before the Royal Meteorological Society, the chief features of the climate of Colorado appear to be: 1. Diminished barometric pressure, owing to altitude. 2. Great atmospheric dryness, especially in winter and autumn. 3. Clearness of atmosphere and absence of fog or cloud. 4. Abundant sunshine all the year round, but especially in winter and autumn. 5. Marked diathermancy of atmosphere, producing an increase in the difference between the temperature in the sun and in the shade, varying with the elevation in the proportion of one degree for every rise of two hundred and thirty-five feet. 6. Considerable air movement, even in the middle of summer, which promotes evaporation and tempers the solar heat. 7. The presence of a large amount of atmospheric electricity. Thus the climate is dry and sunny, with bracing and energizing qualities, permitting outdoor exercise all the year round.

ACCORDING to a paper by Prof. Washington Matthews, of Fort Wingate, New Mexico, read in the American Association, the majority of the very numerous songs of the Navajos are divided into groups and follow in regular sequence; whence they may be called sequence songs. The order of the songs is arranged to correspond with a series of myths, there being a special myth for each set. The set of the "songs in the form of the house god" has thirty songs. In some instances the myth is the more important part of the work; but in more cases it is only a trifling element, and seems devised merely as an aid to the memory, or a means of explaining and giving interest to the songs. The master of ceremonies or leader in the production of these songs, called the *thaman*, must be a man of superior memory and of great intellectual industry. He must commit to memory many hundred songs, some of which are so sacred that the slightest mistake made in repeating them renders void an elaborate and costly ceremonial.

Two reforms in the system of life insurance commended in the English journals are the perfection of a plan by one company the object of which is to lighten the duties of trustees and enable the assurant to make better provision for his wife and children, the details of which are too technical to be published here; and the adoption by another company of a policy affording full and satisfactory information on all subjects concerning its operations and the nature and value of its policies, including those facts by the aid of which the assurant can see for himself what he can get every year upon his policy should he be constrained to sell it or borrow upon it.